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Article

Can a training program on climate change promote pro-environmental behaviors? A pilot study with adolescents

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Abstract: Environmental Education (EE) programs are of crucial importance. EE are aimed at global citizenship to generate new knowledge and new, more participatory and conscious ways of acting in the environment. This study, therefore, wants to verify the effectiveness of a training intervention that is based on education on climate change issues and on the active participation of subjects in the dimension of the small psychological group. At the intervention 309 students took part, equally distributed by gender (52.1% males), 64.4% enrolled in primary school, 35.6% enrolled in lower secondary school. A quantitative protocol was administered to evaluate the effectiveness of the intervention. The study shows an increase in pro-environmental behaviors and their stability even after 15–30 days. The intervention seems to be effective in triggering pro-environmental behaviors and maintaining them in the following weeks. The results of this study highlight the need to develop environmental education pro-grams in schools to increase levels of knowledge and awareness on the issue of climate change.

Keywords: environmental education programs; primary school; lower secondary school; quantitative research; Italy

1. Introduction

Nowadays, the topic of Environmental Education (EE) is considered to be of crucial importance (Lugo Blanco et al., 2021). In fact, EE programs are aimed at global citizenship in order to generate new knowledge and new, more participatory and conscious ways of acting in the environment (Carleton-Hug and Hug, 2010). EE influences people's behavior and this represents a widely accepted assumption in the scientific community (Suárez-Perales et al., 2021). Therefore, educating students to a greater understanding of environmental issues influences their future behaviors (Knafo and Galansky, 2008). Regarding environmental problems, working on changes in attitudes and behaviors—turns out to be the basis for addressing the problem itself (Jaime et al., 2023). People's behavioral change, in fact, can become one of the ways to address the climate crisis, in order to reduce the devastation of natural environments and safeguard the planet (Wu et al., 2020). Within this framework, environmental education at school plays a decisive role in spurring all communities to behavioral change (Earle and Leyva-de la Hiz, 2021). Educating the younger generations towards positive and scientifically correct environmental attitudes has the potential to set their behaviors today, which will then manifest and consolidate as adults (Ballantyne et al., 2006; Whitburn et al., 2023). The study conducted by Otto and Pensini (2017) evaluated the effect of participation in nature-

based environmental education in 4–6-year-old children. The results showed that participation in nature-based environmental education has a positive impact on ecological behavior, mediated by an increase in environmental knowledge. Rousell and Cutter-Mackenzie (2020), doing a systematic literature review, discuss the need to develop new forms of climate change education that involve more active conscious participation by young people

Research conducted by Ojala (2023) highlighted the importance of the emotional sphere and emotions aroused by the problem of climate change. Indeed, the author states how emotions influence young people's acquisition of knowledge about climate change, as well as ethical sensitivity and action competence. Results showed that children used less problem-focused coping and more distancing to deal with concern than the two older groups, also placing more trust in researchers and technological development. According to the theory of age stability, some authors (Alwin and Krosnick, 1991) highlight that adolescent social attitudes are already directed once they reach the end of high school. Therefore, to affect the future behavior of the population in terms of environmental behavior, it is necessary to intervene at an early age, since childhood and adolescence, or when behaviors are still evolving and are not yet crystallized. However, some authors (Choi et al., 2010; Robertson and Barbosa, 2015) believe that the issue of climate change is still little treated in schools, with the consequence that information on this issue is mostly taken from popular information sources, such as the traditional media and social media, which are often unreliable or otherwise distorted and unverified. In particular, to date in the Italian context there are no EE-focused intervention research projects targeting adolescents. However, some studies highlight adolescents' perceptions regarding climate change. Sabato's (2020) survey of Italian teenagers brings out how they represent the generation will witness the most important effects due to change, highlighting how educational offerings devote little space to this topic, leaving this role mainly to social media The results of the research conducted by Antronico et al. (2023) show that Italian students surveyed between the ages of 13 and 20 have awareness and knowledge of the problem of climate change and its effects on nature and the environment, again confirming the decisive role of the mass media.

Therefore, it is important to increase correct knowledge through the inclusion of the topic in school curricula or by encouraging collaboration with external experts, participating in dedicated projects, such as I-CHANGE (http://ichange-project.eu/). I-CHANGE is a project that aims to promote interventions to develop pro-environmental behaviors and the use of citizen science tools. If done correctly right, citizen engagement in participatory research has the potential to create a sense of ownership, through awareness creation and knowledge co-production, and empowerment, by strengthening people's skills, e.g., in monitoring or climate action, and creating community cohesion (Lang et al., 2012; Cash et al., 2002). Living Labs provide an ideal platform for citizen science and engagement in participatory research in a structured, place-specific manner. They also offer a useful forum to examine citizen science as a mechanism to help promote environmental awareness and behavior change.

I-CHANGE Living Labs aim to engage citizens in scientific monitoring using different kinds of sensors, hoping to improve local environmental awareness and

potentially generate behavior change towards a fair sustainability transition. In addition to technical outputs, I-CHANGE also aims to reduce societal knowledge-based inequities through an explicit focus on just sustainability transitions. The challenges in the I-CHANGE project range from the diversity within the interdisciplinary team of researchers and practitioners to the diversity of the Living Labs, located in different countries, being at different stages of development and focusing on different types of citizen science. Every project in Living Lab is unique since—every location has different conditions, including cultural, socioeconomic, political, and biophysical environments. At the same time, diversity creates opportunities of studying different ways of generating awareness and assessing its impacts on behavior. Sinatra et al. (2012). found that students with favorable attitudes toward human-induced climate change are more likely to act with pro-environmental behaviors. Other studies show that environmental knowledge leads to positive attitudes and responsible attitudes towards the environment (Bradley et al., 1999; McMillan et al., 2004), although not all research agrees. Dijkstra and Goedhart (2012) have not found correlations between knowledge of climate change and attitudes related to the environment. We observe two approaches on how environmental education can influence pro-environmental behavior: the instrumental perspective and the emancipatory perspective. According to the first perspective, environmental education is considered as a tool to change the behaviors of specific groups, transmitting environmental issues to them (Fischer et al., 2015; Wals et al., 2008). The second perspective, instead, aims to educate on environmental issues, promoting independent thinking, active dialogue, autonomous action plans (Wals et al., 2008), in a transformative, participatory and constructive perspective (Cincera et al., 2020; Earle and Leyva-de la Hiz; 2021). This second perspective seems to be the most suitable for developing positive behaviors in favor of the environment (Al-Naqbi and Alshannag, 2018; Suárez-Perales et al., 2021; Tolppanen et al., 2023; Whitley et al., 2018). Active participation to produce social change has been widely studied in literature since 1940's with Lewin's studies, which are still the basis of many methods to promote social change. The method based on small psychological group and social comparison are the elements that can favor a process of greater awareness and empowerment of the individual and the community and that allow a new positioning with respect to pro-environmental attitudes and behaviors and maintenance of the decision and position taken more lasting over time (Munerol et al., 2022).

This study, therefore, wants to verify the effectiveness of a training intervention that is based on education on climate change issues and on the active participation of subjects in the dimension of the small psychological group, to promote a correct knowledge of the phenomenon and encourage pro-environmental behaviors in adolescents.

2. Climate change risk perception and behavioral change

Climate change risk perception refers to how individuals and communities perceive and assess the risks associated with climate change. It encompasses the subjective evaluation of the potential threats, impacts, and consequences of climate

change on various aspects of life, including the environment, economy, society, and personal well-being. Climate change risk perception is a crucial aspect of climate change communication, adaptation, and mitigation efforts because it influences people's attitudes, behaviors, and decision-making regarding climate-related issues. Risk perception scholars have proposed several models trying to tackle the complexity of the factors affecting how we represent risks (Slovic, 2010). As stated by van der Linden (2015), climate change stands out as a unique subject in the context of risk perception. What sets it apart is its exceptional combination of magnitude and complexity, which is unparalleled both in terms of its global scale and the extensive timeframe over which it unfolds. Furthermore, climate change distinguishes itself by being a gradual, cumulative process, mostly imperceptible to direct human experience (Weber, 2010). This characteristic markedly differs from the way our ancestors traditionally perceived immediate threats in their local environments (Gifford, 2011; Helgeson et al., 2012). Consequently, human-induced climate change represents a "novel" risk in evolutionary terms (Griskevicius et al., 2023). One of the most comprehensive frameworks concerning the perception of risks related to climate change is the Climate Change Risk Perception Model (CCPRM) (van der Linden, 2015; van Eck et al., 2020). It is a multidimensional framework that aims to understand how individuals and communities perceive and respond to the risks associated with climate change. Developed in response to the urgent need to address climate change and its impacts, this model provides a valuable tool for researchers, policymakers, and practitioners to enhance climate change communication, adaptation, and mitigation efforts. After an extensive literature review, the authors identify the key components of climate change risk perception as:

- Cognitive Factors, related to knowledge of causes, impacts and possible responses to climate change, trust in scientific institutions and the knowledge of scientific consensus about the evidence of climate change.
- Experiential processing, related to personal experience with extreme weather events and emotional activation concerning climate change issues.
- Socio-cultural norms, related to the perception of alignment between one's own perspective and those of the social and cultural group, but also to value orientation e.g., (egoistic, socio-altruistic, and biospheric values).
- Socio-demographic factors, like age, education, political orientation, etc.

The Climate Change Risk Perception Model offers a comprehensive framework for understanding how individuals and communities perceive and respond to climate change risks. By considering cognitive, affective, social, and contextual factors, the model provides valuable insights that can inform communication strategies, policy design, community engagement, education, and long-term planning. However, perceiving a risk is not enough to ensure behavioral change, especially concerning climate change (Gifford, 2011; DeWaters and Powers, 2014; Schultz et al., 2005). Several factors could mitigate or even dampen the willingness to act, for instance the attitudes towards the required actions. People may feel that the pro-environmental behaviors are ineffective, that the social norms about them are skeptical or openly hostile, that their personal self-efficacy is low, and they cannot control the situation (Xie et al., 2019). In addition, people may accept the risk as the price to pay for an

immediate advantage provided by non-eco-friendly actions, or they may think that they do not have personal or material resources to act (Wachinger et al., 2013). From the psychological point of view, pro-environmental behavior has been studied by the theory of reasoned action—"TRA" (Fishbein and Ajzen, 1977; Ajzen and Fishbein, 1980), the theory of planned behavior—"TPB" (Ajzen, 1991) and the theory of self-determination—"SDT" (Ryan and Deci, 2000).

TPB—which is in fact an extension of TRA—argues that any human behavior, defined as the manifest and observable response in each situation with respect to a given goal, is determined by behavioral intentions based on attitude toward behavior, subjective norms, and perceived behavioral control. Attitudes towards behavior refer to how a person rates favorably or unfavorably the implementation of the behavior under consideration, subjective norms refer to the perception of whether significant others (e.g., peers) approve or disapprove of a certain behavior, while perceived behavioral control reflects the extent to which a person perceives whether or not they possess the personal skills necessary to perform a certain behavior and the control it believes to have over it. Scientific evidence shows that behavior is driven by motivation. According to SDT (Ryan and Deci, 2000) people can be proactive or passive, depending on the social conditions in which they are involved. Self-motivation can be favored or inhibited by different situations, and SDT distinguishes two main types of motivation: autonomous motivations, which include both intrinsic motivation and the types of extrinsic motivation that people have identified with the value of an activity that would ideally complement their sense of self; controlled motivations that, instead, consist of both external regulation and introjected regulation of some aspects such as avoidance of shame, contingent self-esteem and ego involvement (Deci and Ryan, 2008). Autonomous motivation tends to produce greater psychological health and more effective performance. Another important aspect of the theory concerns the recognition of individual psychological needs. According to Ryan and Deci (2000), there is a set of universal needs that must be met for effective functioning and psychological health; they argue that the needs of competence, autonomy and relationship predict psychological well-being in all cultures (Deci and Ryan, 2008; Ohajunwa and Mji, 2018). Competence consists of feeling able to act on the environment and achieve a desired goal, while autonomy refers to the possibility of freely deciding what is best for oneself. The need for relationality concerns the need to maintain and establish relationships in a social environment. The vitality of basic psychological needs allows people to act more autonomously and to persevere in important activities (Ryan and Deci, 2017). Considering, therefore, the SDT as a framework to raise awareness on climate change, in the educational intervention described below we have solicited both autonomous and controlled motivations, with particular attention to the need for competence, autonomy and relationality, to achieve a greater knowledge of environmental dynamics, which also facilitates the mental well-being of individuals.

In summary, climate change risk perception can serve as a catalyst for behavioral change, but it is not the sole determinant. The relationship is influenced by a combination of cognitive, emotional, social, and contextual factors. Effective climate change communication, policy interventions, and community engagement efforts should consider these factors to promote pro-environmental behaviors and

contribute to climate change mitigation and adaptation.

3. The intervention project

The intervention project aims to detect the attitudes of pre-adolescents and adolescents towards climate change and the behaviors related to it. It involved adolescents from primary school (fourth and fifth grade) and lower secondary school (sixth-seventh and eighth grade), because they were particularly sensitive groups to the topic, open to personal modification and possible drivers of change within family contexts. For this reason, the action research project has the following objectives:

- Raising awareness about climate change: the process, its causes and consequences.
- Promote awareness that the use of more sustainable behavioral models helps safeguard the planet.
- Promote complex thinking about climate change mitigation and adaptation.
- Evaluate the acquisition of environmental, weather or climate knowledge, reinforced by concrete workshops.

The intervention has been structured within the school curriculum in synergy with the most relevant disciplines to involve teachers in a process aimed at raising awareness and stimulating personal responsibility concerning climate change. Four meetings were organized over a four-month period lasting two hours each. In each meeting a theme was proposed, first focused on delivering the technical knowledge and then fostering open discussion in small groups with the aim of identifying appropriate behaviors applicable in everyday life, tangible and assessable. The tool of the small psychological group and social comparison will (was?) be used; in this way it is possible to encourage the process of awareness and empowerment of the individual, but also to strengthen the positioning of the individual with respect to the topics under discussion and its maintenance over time. The first and third meetings were conducted by CIMA Research Foundation experts with interactive content lessons on different topics of climate change. During the first meeting, related to the definition of climate change, known drivers of climate change phenomena, how climate change can be measured based on paleoclimatic as well as historical data are defined; after this consciousness, the role of the water cycle and future climate scenarios are addressed. The third meeting, conversely, has been devoted to the description of examples of severe meteo-hydrological phenomena climate change induced, to the identification of adaptation measures (e.g., early warning activities), and finally to the discussion of possible mitigation actions of human carbon footprint. The second and fourth meetings were conducted by experts-teachers with psychology skills aimed at the consolidation, deepening and discussion of the previously shared topics in small groups and with laboratory activities. In these two meetings, participatory strategies were used to allow comparison, more direct learning and greater awareness of the most appropriate behaviors. In fact, the objective of the in-depth and consolidation workshops was to identify appropriate behaviors in line with the contents treated in the preliminary lessons, applicable in everyday life, tangible and assessable.

4. The research

The research we are going to present is within the intervention design just described and aims to evaluate its effectiveness through a quantitative pre-intervention post-intervention method (see **Figure 1**).

Aims

- Evaluate the effectiveness of behavioral change.
- Evaluate the effectiveness of an educational path on climate change.
- Evaluate the training-school protocol.

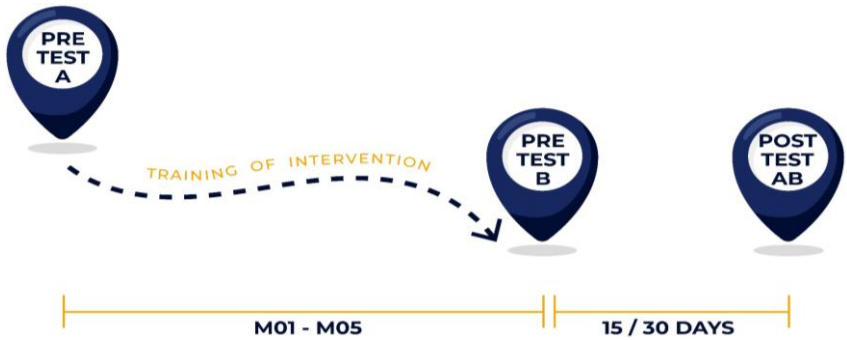

Figure 1. Research design.

5. Materials and methods

The research team made agreements with some schools in a rural area near a medium-sized city in the north-west Italy to propose intervention training and research. The project was welcomed with enthusiasm by the teachers who conveyed the proposal to families and students. Furthermore, the teachers supported the project by integrating the topics covered by the training into their curricular teaching to strengthen the acquisition of the contents transmitted during the training. The training was carried out within the classes by the members of the research team depending on the topics covered. The overall project lasted 6 months. The training intervention lasted 4 meetings over two months. The research protocol was always administered by the researchers within the individual classes. The data were collected in accordance with the ethical recommendations of the Declaration of Helsinki and in compliance with the American Psychological Association (APA) standards for the treatment of human volunteers. Only fully completed questionnaires were analyzed.

5.1. Measures

- Knowledge assessment tool: created by the design team, experts in climate change and psycho-social research methods, on the knowledge content that will be addressed during the training. It is composed of 7 items (e.g., “What is the carbon footprint?”). Multiple choice question, with only one correct option. Administered in pre-test A and post-test A.
- Climate change attitude: (Christensen and Knezek, 2015) modified and back translated by the authors) measures students’ beliefs and intentions towards the

environment. 15 items with a 5-point Likert scale (strongly disagree/strongly agree), two dimensions concerning beliefs (e.g., "Global climate change will impact our environment in the next 10 years") and intentions (e.g., "My behaviors affect the quality of the environment"). Administered in pre-test A and post-test A. This scale was administered only to students of the lower secondary school.

- Pro-environmental behaviors: measured throughout a set of items called Fantaclima created ad hoc by the design team on everyday pro-environmental behaviors. 45 items (e.g., "I went to school by foot or by bicycle"). 5-point Likert scale never/always. Administered in pre-test B and post-test B. 45 items divided into 7 subscales: recycling collection (an example of a question At home we sort plastic and aluminum), when we eat (example At home we drink tap water instead of bottled water), when I wash (example I turn off the water while brushing my teeth), when I dress (example When I feel cold I put on an extra sweater instead of turning up the radiator), at home (example When I dry my hands I use a cloth rag and not the paper towel), at school and on the go (example I walk or bike to school), In the post-test the same questions were used with the addition of the subscale I asked (example In the last week I asked my family if all the light bulbs in my house were energy efficient).

5.2. Data analysis

Statistical analysis was conducted using SPSS (version 18). First, descriptive statistics were calculated for each measure. After, a series of paired-samples T-tests were conducted to investigate pre- and post-test differences in the total sample and gender differences.

6. Results

6.1. Participants

At the intervention 309 students took part, equally distributed by gender (52.1% males), 64.4% enrolled in primary school, 35.6% enrolled in lower secondary school. However, since the questionnaires were administered in three different moments (Pre-Test A, Pre-test B, and Post-test B), in the following tables the numbers of participants depend on the presence of the students at the moment of the data collection.

6.2. Knowledge assessment

Concerning knowledge of climate change issues, a statistically significant increase was noted in the two school orders as reported in **Table 1** between the pre-test and the post-test. Both elementary school students and lower secondary school students who participated in the proposed intervention project show a significant increase in knowledge.

Table 1. Descriptive statistics and pre-post comparison for the total sample in the knowledge assessment.

		Pre-test A	**Post-test A**	***T*-test**			**Cohens'd**
Participants	***N***	**M (SD)**	**M (SD)**	***T* (gdl)**	***p***	**M diff**	
Primary school	176	4.07 (1.63)	4.81 (1.77)	−5.70 (175)	<0 .001	−0.74	0.43
Lower secondary school	93	4.26 (1.64)	5.23 (1.74)	−4.834 (92)	< 0.001	−0.97	0.57

6.3. Climate change attitude

Concerning the scale of beliefs and intentions, there are no significant differences between the pre-test and the post-test (see **Table 2**). Similarly, no significant differences are observed in relation to gender. However, the scores of the participants of the lower secondary school are already high, in a 5-point Likert scale the participants obtain values higher than 4 concerning beliefs and just below 4 concerning intentions for pro-environmental actions.

Table 2. Descriptive statistics and pre-post comparison for the total sample in the climate change attitude.

	Pre-test A		**Post-test A**		**T-test**		
Measures	**N**	**M (SD)**	**N**	**M (SD)**	**T (gdl)**	***p***	**M diff**
Beliefs	86	4.12 (0.45)	86	4.20 (0.53)	−1.54 (85)	0.127	−0.08
Intentions	87	3.99 (0.58)	87	3.94 (0.77)	0.711 (86)	0.711	−0.05

6.4. Fantaclima: Pro-environmental behaviors

Regarding pro-environmental behaviors, the results show an increase at the post-test conducted 15 to 30 days after the end of the training course, although no significant differences emerge pre-post (see **Table 3**).

Table 3. Descriptive statistics and pre-post comparison for the total sample in the pro-environmental behaviors.

	Pre-test B		**Post-test B**	***T*-test**			**Cohens'*d***
Participants	***N***	**M (SD)**	**M (SD)**	***T* (gdl)**	***p***	**M diff**	
Primary school	153	130.67 (25.46)	136.27 (25.57)	−3.20 (152)	0.002	−5.60	0.21
Lower secondary school	95	136.25 (24.01)	141.20 (28.85)	−3.044 (94)	0.003	−4.95	0.19

7. Discussion

The main objective of the project was to test the effectiveness of the intervention to replicate it and disseminate it in other contexts. The results demonstrate the effectiveness of the intervention with an increase in knowledge about the topics of the training course for all the students involved, highlighting the adequacy of the proposed contents and the ability of the group of trainers to adapt the contents to the different ages of the students involved. Moreover, the study shows an increase in pro-environmental behaviors and their stability even after 15-30 days. Therefore, the intervention seems to be effective in triggering pro-environmental behaviors and maintaining them in the following weeks. As stated by Mónus (2022), who conducted research in a secondary school on environmental

education, a change in student attitude and behavior is crucial to leading society toward a transition to sustainability. In support of this Parede-Chi and Viga-de Alva (2020) used action research methodology applied to environmental education arguing for the need to integrate new teaching methods based on participation and critical inquiry to improve the relationship between school and community in addressing environmental issues. Since the pro-environmental beliefs and intentions of the participants were already strong before the training, they may have positively affected the motivation to learn the new contents, thus leading to an increase in knowledge. At the same time, these beliefs and intentions could have affected the development and maintenance of pro-environmental behaviors. Along the same lines from the systematic review conducted by Stern et al. (2014) emerges the crucial role of EE programs in achieving positive change in knowledge, awareness, skills, intentions, and even behavior. Our data found no gender-related differences, although studies in the literature have shown different data. For example, Leppänen et al. (2012) found that females have more positive attitudes towards the environment than male. More recently, the study conducted by Jurek et al. (2022). revealed that compared to females, male students possess a greater degree of understanding of the causes and consequences of climate change. In addition, the results highlight how the participants have strong beliefs about climate change and, above all, their possibility to have an impact on it. This leads us to think that, in line with the work of Christensen and Knezek (2015), even the pro-environmental behaviors consolidated after the training can be maintained over time as anchored to their idea of being able to affect climate change.

8. Conclusions

The results of this study highlight the need to develop environmental education programs in schools to increase levels of knowledge and awareness on the issue of climate change. This will, in fact, have crucial repercussions on the pro-environmental behaviors that students decide to implement. However, beyond these positive data, it is necessary to highlight some limitations of the study. First, the absence of a control group. Secondarily, the project did not schedule a third administration to test long-term effects after the training. This further administration would have made it possible to verify the durability of pro-environmental behaviors over time. Certainly, this limit could be considered in future research to evaluate the effectiveness of the intervention over time, especially for what concerns pro-environmental behaviors. The research was conducted in only two institutions in northern Italy and this may be a limitation. However, the favorable results may be a starting point for implementing this type of project in other schools in central and southern Italy as well to test its effectiveness. In addition, the results of these studies highlight how education plays a key role. Working with the younger generation means building the foundation for developing a more environmentally conscious and sensitive culture. However, there are other factors that need to be considered that may influence whether one chooses to enact pro-environmental behaviors. For example, the social and family context of reference can play a determining role. Indeed, the attitudes of friends and parents have a strong impact on adolescents'

attitudes (Robinson et al, 2019). Parental behavior and family norms influence adolescents' pro-environmental behavior (Grønhøj and Thøgersen, 2017). For this reason, future intervention research programs should also consider these factors to be able to propose promotion and awareness interventions aimed at the wider community. This work, therefore, is intended to be a starting point, which, by working on the educational process, aims to build an aware and responsible culture on the phenomenon of climate change that involves all citizenship. Working, in fact, on achieving greater awareness of one's individual behaviors, with a view to change, can bring a benefit to the entire community.

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