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Challenging the free-rider: Children behavior in a public goods game☆

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ABSTRACT

This paper presents the results of an educational program designed to promote prosocial attitudes among 11-year-old children in Southern Italy. The experiment investigates whether education on socially beneficial behavior can increase voluntary contributions in a standard public goods game and reduce free riding. The program consists of five interactive lectures delivered by young economics students on sustainable consumption, social responsibility, and environmental awareness. Results suggest that participation in the program significantly increases both the probability of contributing and the size of contributions. Interestingly, the transmission of prosocial behavior appears to have a stronger impact among students from lower socio-economic backgrounds.

1. Introduction

Contribution to public goods is essential for any prosperous and well-structured society. However, cooperation is never optimal for rational, self-interested agents in social dilemmas, where full free-riding is the only dominant strategy. The tendency to prioritize individual well-being over the common good can lead to an insufficient provision of public goods or even their collapse, especially in contexts characterized by civic disengagement and a lack of trust among community members. Understanding how cooperation can be incentivized is therefore crucial for designing effective policy interventions that promote contributions and reduce free riding.

Experimental economics is widely focusing on children and adolescents to understand how the ability to make strategic choices develops over time. This stream of research aims to design childhood programs and policies that address suboptimal decisions well in advance, preventing negative long-term consequences (Brocas & Carrillo, 2021; Harbaugh et al., 2001; Sutter et al., 2019). In the literature, collective cooperation is often enforced through the presence of institutions, whether exogenous or endogenous, that condemn and punish selfish behavior (Kamei, 2020; Kosfeld et al., 2009; Ostrom et al. 1992).[1] In this paper, we investigate whether cooperation can be encouraged among school children through the transmission of social norms and shared values, rather than through coercive measures. We adopt the definition of social norms proposed by Cialdini and Trost (1998), who state: "*Social norms are rules and standards that are understood by members of a group, and that guide and/or constrain social behavior without the force of laws*". According to Fehr and Fischbacher (2004) the effectiveness of legal enforcement itself relies on social norms. In fact, laws that are not supported by widely shared norms lose legitimacy and can weaken compliance and social cohesion.

We report the results of a classroom experiment conducted during the 2023–2024 school year in three middle schools in Catania (Italy). The experiment involved 235 children from sixth-grade classes and consists of five lessons on social responsibility, sustainable consumption and environmental awareness, supplemented by group activities. As is standard in this type of literature, we assess children's inclination toward free-riding using an incentivized linear public goods game (PGG). We provided children with an initial endowment and asked them to secretly decide whether and how much to contribute to a common pot, which would then be equally shared among all participants. In a PGG, the contribution of each participant increases the total amount available for the public good. A purely self-interested participant, however,

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[1] From the seminal work of Olson (1965), collective action can be encouraged through *selective incentives* that reward contributors and penalize free-riders. Additional factors that can motivate prosocial behavior include social preferences (Capraro & Perc, 2021) and expectations about others' contributions (Fischbacher & Gächter, 2010).

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is expected to contribute nothing and rely entirely on the contributions of others to benefit from the public good.

Many experiments on fairness and social preferences have been conducted with 20-year-old university students as participants (Konow, 2019; Mayhew & Murphy, 2009). In our experiment, economics students take on the role of instructors, leading lessons for 11-year-old children.[2] We speculate that the exposure to and promotion of prosocial attitudes can foster the transmission of social norms. Our conjecture is based on the literature on conditional cooperation (Fischbacher et al., 2001), which can arise, among other reasons, from conformity, that is, the observation and imitation of others' behavior. Conformity can be normative, where individuals voluntarily adhere to a perceived social norm (Bernheim, 1994), or informational, which stems from social learning about optimal choices (Bandura, 1986; Bikhchandani et al., 1998). Frontal lectures and group activities attempt to address both dimensions, thus increasing the likelihood that these values will not only be learned, but also internalized as habitual behaviors (Bentler & Speckart, 1979; Bicchieri, 2002), rather than merely adopted through incentivized choices (Hodgson, 2010).

To evaluate the effectiveness of the educational program, we randomly selected the classes to be assigned to the treatment. We then compared the PGG results of treated and control classes, both before and after the program's implementation, through a Difference-in-Differences (DiD) approach. Our analysis focuses on behavioral changes along two dimensions: (*i*) the *extensive margin*, that is, whether the program increases the probability of contributing to the provision of the public good, (*ii*) the *intensive margin*, that is, whether the program increases the amount of contributions made. The results show that the program has significant differential effects on children treated and suggest that lessons from younger adults on social norms influence the approach to common goods.

We also investigate potential heterogeneous effects of the educational program across children of different socio-economic status (SES). In the sociological literature, it is widely acknowledged that the amount of economic, social, and cultural resources invested in children's development depends on the SES levels of parents (Conger & Donnellan, 2007; Lareau, 2002). High-SES families generally invest considerable time and resources in education of their children, which can limit the additional impact of the program. In contrast, low-SES families often have limited resources to invest and tend to rely on schools for educational support. In these cases, the program may have a greater potential to influence and shape social values, as it can help fill the gaps left by families. Our findings reveal a significant and positive treatment effect on low-SES children, while that on high-SES children is positive but not statistically significant. The lack of significance for the latter highlights the greater effectiveness of the program for low-SES children, who benefit from additional support in value formation and social development.

The PGG literature is paying growing attention to the role of norms in shaping contribution behavior (Biel & Thøgersen, 2007; Caserta et al., 2023; Hermes et al., 2020; Mankat, 2024).[3] Our results complement this literature by showing that education on social norms promotes prosocial behavior among school children, especially among low-SES students. The following sections outline the experimental method, hypotheses, and results. The final section concludes. The Appendix A includes the original framework of the game, a detailed description of the meetings, and the instructional materials used.

[2] Students received specific training from professional tutors in the two months before the program started. The educational material used during the treatment was designed by professional tutors together with students/instructors. This helped make sure the material was clear for instructors to teach and suitable for the target age group.

[3] See Sutter et al. (2019) for a survey on cooperative behavior of children and adolescents.

2. Experimental method and procedure

The experiment took place in three different lower secondary schools in Catania, Italy, during the 2023–2024 school year. The experiment involved 17 classes and 235 11-year-old students, tested before and after treatment, resulting in 470 observations.[4]

Compared to online experiments, those conducted during school hours have two key advantages. First, the school environment helps reduce dropout rates, as participants are more likely to perceive the experiment as mandatory, similar to other school activities. Second, since the educational stage is part of compulsory education, this setting minimizes possible selection effects (Alfonso-Costillo et al., 2022; Sutter et al., 2013).

In January 2024, we ran the first round of the game and collected data on personal and family characteristics upon parents' formal approval. We conducted a cluster randomized trial (CRT) to assign the treatment at the class level. This approach is suitable compared to individual randomization when participants are ex-ante grouped into cluster. In the school environment, students are typically distributed in relatively homogeneous classes and accustomed to participating in group activities. In addition, students within the same class are likely to influence one another, making individual randomization less effective. The CRT, instead, minimizes the risk of contamination, as students in the same class are exposed to the same treatment, enhancing the internal validity of the experiment.[5]

Among the three schools, the randomization process assigned seven classes to the treatment group and the remaining ten to the control group. Across the three schools, the two groups were evenly distributed, with treatment-to-control ratios equal to 41.2%, 41.8%, and 39.4%. Table 1 presents baseline individual statistics for a set of dummy variables used as controls in the empirical analysis. These include gender, presence of one sibling, living with both parents, receiving pocket money, and low socio-economic status. The latter is proxied by the number of books students report having at home — specifically, fewer than 25 books. Balancing test confirms that no starting differences arise between treated and control groups.[6]

Table 1
Sample characteristics and balancing test at the baseline.

	Mean	S.D.	Control	Treated	*p-value*
Female	0.587	0.032	0.597	0.573	0.712
At most one sibling	0.638	0.031	0.683	0.573	0.084
Living with both parents	0.885	0.021	0.871	0.906	0.400
Low-SES	0.519	0.033	0.489	0.562	0.271
Pocket money	0.664	0.031	0.633	0.708	0.232

Notes: The total sample consists of 235 observations. The treated group has 96 observations while the control group has 139 observations. *p-value* refers to the difference between treated and control group.

2.1. Treatment

The educational program consists of five meetings, each lasting about two hours and held weekly, started a month after the baseline evaluation. The treatment adopted a game-based approach to promote learning in an interactive and enjoyable way for school children. Each session was aimed at understanding students' behavior towards others

[4] The analysis excludes students who received support from a teaching assistant or were not present during data collection in both the pre- and post-treatment periods. The final sample includes 235 students, with 139 in the control group and 96 in the treated group.

[5] While we acknowledge that some interactions among schoolmates may have occurred despite the class-level randomization, such interactions — if any — would lead to an underestimation of the program's true impact, as they could positively influence contribution behavior within the control group. In this case, the estimated treatment effect should be interpreted as a lower bound of the program's potential effectiveness.

[6] Data are available upon request.

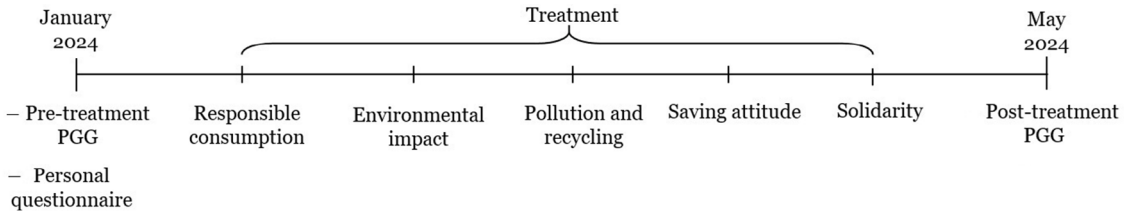


Fig. 1. Experiment timeline.

and the surrounding environment, while encouraging them to avoid wasting public resources. Meetings were divided into three main parts: frontal lectures, group activities and final evaluation.[7]

Lectures treated five different topics — one for each meeting — on responsible consumption, sustainable environmental education, recycling, responsible resource use, and solidarity. Speakers used PowerPoint presentations, videos and images to catch students' attention and stimulate their curiosity but also to ensure a standardized delivery of the lectures across classes (Hermes et al., 2020). The goal was to encourage students to reflect on the dynamics of sharing and the importance of contributing to social goals, using simple language. For the group activities, students were randomly assigned to groups of five or four according to the class size. Each member was given a specific role to help the group achieve a common goal. The activities were designed not only to promote the acquisition of knowledge, but also to encourage participants to work together, collaborate, and develop critical thinking. At the end, groups were asked to share their work with the class and to evaluate themselves for their ability to respect assigned roles, solve problems, and creativity.

Given the broader range of topics covered during the lessons and the evaluation method employed, we tend to exclude the possibility of teaching-to-the-test effects, which could otherwise inflate the treatment effect and bias the results. Economics students participated in the program on a voluntary basis and ignored that children would have been subjected to evaluation. The PGG was then conducted in their absence.

While the treatment group was exposed to the educational program, the control group continued with their regular school lessons. The treatment activities were carried out during class hours, with all students remaining in their respective classes, so that only the treated group met and interacted with the tutors. This ensures that the control group was unaware of the activities taking place in the treatment classes, further minimizing contamination effects.

Fig. 1 presents the timeline of the experiment.

2.2. Evaluation method

A linear PGG was conducted in both treated and control classes before and after treatment to evaluate changes in the students' contribution behavior. The game was held on a single day at each school and lasted about 30 min per class. Students played in their classrooms, seated far apart to prevent interactions and reduce reputation as well as contamination effects. Additionally, participants were asked not to reveal the game to their schoolmates to reduce potential learning effects, which could bias the results at the baseline.

We distributed an envelope to each student, calling them up in alphabetical order. Each envelope was labeled with a unique random number to identify students while ensuring anonymity. The envelope contained a questionnaire with a table, shown in Fig. 2, along with personal questions. We then read the instructions aloud and allowed students to raise questions to ensure they correctly understood the game.

To make the experiment not only educational but also enjoyable, we represented contributions to the common good with slices of pizza, which can be a familiar and appealing element for schoolchildren. This simple framework helps us to avoid possible cognitive failures which are likely to arise in this type of game (Andreoni, 1995). Students were asked to choose one out of four options to decide how to allocate 3 slices of pizza between themselves and a common plate. The slices placed in the common plate were then equally redistributed among all students participating in the experiment across the three schools — rather than limited to individual classes — regardless of individual contributions. Since participants belong to different schools, they are unlikely to know each other. This redistribution approach is intended to minimize the potential influence on contribution behavior of friendships and reciprocity, which tend to arise when donors are familiar with each other (Brañas-Garza et al., 2012).

We chose a linear PGG to remove any strategic component from the contribution decision. This design allows us to interpret any observed increase in contribution behavior — relative to the baseline — as evidence of changes in social values and preferences, rather than as strategic responses to economic incentives that could arise from the presence of multiplicative factors when donating to the common pot. The literature on public goods indeed suggests that donations to the common pot reflect interpersonal preferences and altruism (Camerer, 2011). Moreover, if the group's payoff enters the donor's utility function, contributing to the provision of public goods is consistent with the economic rationality of utility maximization (Ledyard, 1995). Our methodological choice thus strengthens the validity of the evaluation of the program's effects on prosocial behavior.

Given the options in Fig. 2, each student decides whether and how much to contribute to the public good. Each slice has a symbolic value of €0.20, convertible into a voucher redeemable at a local bookstore for books, video games and comics.[8] Students were informed that they could keep all the pizza slices for themselves and that their contributions were anonymous. They indicated their choices by marking the desired option on the table with a check. Once all decisions were made, envelopes were collected. The prizes were distributed in sealed envelopes one week after the game ended. This approach makes the experiment more tangible and stimulating, encouraging participants to reflect on the importance of sharing and cooperation, while also offering a real reward to induce active participation and thoughtful decision-making.

2.3. Predictions

Our experimental design enables us to single out three main hypotheses.

[7] Within the social psychology literature, Campbell (1958) argues that aggregating individuals within groups can foster their tendency to cooperate.

[8] The PGG was the first of several incentivized games played by children as part of a broader Rutgers project. The €0.20-per-slice payoff refers specifically to the PGG and represents only one component of the experimental session. As initial game in the sequence, it is unlikely that students' decisions were influenced by the outcomes of subsequent games. Across all games played, the average total reward was approximately €3.50, with individual earnings ranging from €2 to €6.

	Pizza for you	Pizza to share
A)		0
B)		
C)		
D)	0	

Fig. 2. Public good game matrix.
Options translated from Italian.

Hypothesis 1. Extensive margin.

Participating in the educational program increases the likelihood of contributing to the public good.

Hypothesis 2. Intensive margin.

Participating in the educational program increases the contribution amount to the public good.

In addition, we expect that the impact of the educational program along the extensive as well as the intensive margin is different among subjects of different socio-economic status.

Hypothesis 3. Heterogeneous effects between high- and low-SES students.

The effect on both extensive and intensive margins is likely to be stronger among low-SES participants.

3. Experimental results

We use two different dependent variables, *Sharing* and *Amount* to test our hypotheses. The variable *Sharing* is a dummy variable that takes on value of 1 if students choose to contribute to the public good and 0 if they choose not to. The variable *Amount* is a continuous variable that measures the percentage of resources allocated to the public good. Among the set of dummy variables used as controls, the key regressor is the interaction variable *Treatment* · *Period*, which captures the effect of changes in the decision on whether and how much to contribute to the public good after the treatment. Throughout the analysis, we control for school-fixed effects to account for unobserved, idiosyncratic, school-specific characteristics that could affect the estimates.

The results presented in Table 2 show that the educational program has a significant effect on both dependent variables considered. Specifically, to determine whether the treatment increases the likelihood of contributing — the extensive margin — we estimate a probit model with *Sharing* as dependent variable. Columns 1 and 2 show that the treatment increases the extensive margin by almost 19 percentage points, with the interaction term *Treatment* · *Period* statistically significant at the 5% level. To test whether the treatment increases the magnitude of the contributions — the intensive margin — we estimate an OLS regression with *Amount* as dependent variable. The outcomes, reported in columns 3 and 4, show that the treatment raises the contribution amount by about 9 percentage points, with the coefficient of *Treatment* · *Period* statistically significant at the 10% level. Overall, the probability of donating is 60% for students who participated in the educational program compared to 41% for those in the control group. Among treated students, the average donation is 28%, whereas it is only 18% for those not exposed to the treatment.[9] Our results therefore provide empirical support for Hypotheses 1 and 2, confirming that the educational program positively affects both the decision to share and the contribution amount.[10]

From Table 2, two observations are worth highlighting. First, the coefficient of the control variable *Female* is positive and statistically significant at the 10% level in both specifications of columns 2 and 5. This indicates that, compared to the male counterpart, girls are more likely to contribute to the public good and tend to make larger donations. This finding aligns with the evidence that girls exhibit stronger preferences for egalitarian outcomes (Brañas-Garza, 2024). Second, the coefficient for the *Low-SES* variable is positive, although it is only statistically significant at the 10% level in the specification presented in column 2, and not in the others. This may suggest that low-SES children tend to contribute more to the PGG even at baseline. While this higher contribution rate might seem to contradict our initial hypothesis, the experimental literature suggests that individuals from less advantaged backgrounds often exhibit stronger prosocial behavior because solidarity and mutual support are key strategies for coping with resource scarcity (Kraus & Keltner, 2009; Piff et al., 2010).

To test Hypothesis 3, we interact the variable *Treatment* · *Period* with the students' socio-economic status. We use the two complementary indicators: *High-SES* and *Low-SES*. The variable *High-SES* is defined as a dummy equal to 1 if students report having at least 25 books at home, whereas *Low-SES* equals 1 if students report having strictly less than 25 books. In the economic literature, the number of books in a household is widely recognized as a reliable indicator of a family's cultural, social, and economic background (Engzell, 2021). It embeds factors such as parental education, literacy levels, and family values (Hanushek & Woessmann, 2011). This variable also allows us to assess the socio-economic status of students without incurring in potentially sensitive questions, such as family income or parents' occupation.

Table 2 shows that, among low-SES students, the probability of contributing to the public good increases by approximately 27 percentage points, as shown in the probit model in column 5, while the amount contributed increases by about 15 percentage points, as shown in the

[9] Table 2 also suggests that free-riding increases in the second round of the game, as the coefficient of the variable *Period* is negative and statistically significant. The experimental literature suggests several factors explaining why contributions may decline over time. For example, a better comprehension of the game and the payoff structure, gained through repetition and experience, may lead participants to contribute less.

[10] Our results remain robust in a sensitivity analysis that sequentially excludes one class at a time. While this procedure reduces the sample size, increasing standard errors, the coefficients remain positive across all iterations. Specifically, the estimated effects range from 0.42 to 0.81, with marginal effects between 16.4 and 32.4 percentage points, for the variable *Sharing* and from 10.4 to 18.7 percentage points for the variable *Amount*.

Table 2
Estimation results.

Variables	(1) Sharing	(2) Sharing	(3) Amount	(4) Amount	(5) Sharing	(6) Amount
Treatment·Period	0.460**	0.472**	0.091*	0.093*		
	(0.203)	(0.203)	(0.052)	(0.052)		
Treatment·Period·Low-SES					0.689**	0.148**
					(0.309)	(0.066)
Treatment·Period·High-SES					0.211	0.021
					(0.245)	(0.047)
Treatment	0.045	0.019	0.003	−0.005	0.026	−0.003
	(0.333)	(0.346)	(0.079)	(0.079)	(0.345)	(0.079)
Period	−0.571***	−0.574***	−0.139***	−0.141***	−0.573***	−0.141***
	(0.164)	(0.166)	(0.033)	(0.033)	(0.165)	(0.033)
Low-SES		0.243*		0.033	0.149	0.007
		(0.137)		(0.029)	(0.132)	(0.026)
Female		0.249*		0.028	0.250*	0.028
		(0.129)		(0.032)	(0.132)	(0.032)
At most one sibling		−0.055		−0.053	−0.055	−0.052
		(0.161)		(0.043)	(0.162)	(0.042)
Living with both parents		0.035		−0.051	0.022	−0.055
		(0.219)		(0.050)	(0.218)	(0.050)
Pocket money		0.095		0.032	0.099	0.034
		(0.096)		(0.029)	(0.095)	(0.028)
Constant	0.221	−0.036	0.291***	0.328***	0.018	0.342***
	(0.264)	(0.323)	(0.054)	(0.080)	(0.326)	(0.081)
School fixed effects	YES	YES	YES	YES	YES	YES
Observations	470	470	470	470	470	470
Marginal effects:						
Treatment·Period	0.183**	0.188**				
	(0.081)	(0.082)				
Treatment·Period·Low-SES					0.274**	
					(0.125)	
Treatment·Period·High-SES					0.083	
					(0.096)	

Notes: Robust standard errors clustered at the class level in parentheses.
* Significance at 10%.
** Significance at 5%.
*** Significance at 1%.

OLS analysis in column 6. In both specifications, the interaction term *Treatment · Period · Low-SES* is statistically significant at the 5% level. In contrast, for high-SES students, the interaction coefficients are positive but not statistically significant (columns 5 and 6). It is worth noting that the difference in the treatment effect between low- and high-SES children is approximately 19 percentage points in the probability of contributing and 12.7 percentage points in the amount contributed. This suggests that the effectiveness of the treatment appears to be mainly driven by the low-SES group. These findings indicate that the educational program has a stronger and positive impact among low-SES participants, increasing both the likelihood and magnitude of the contributions.

The observed increase in contributions may stem from two factors: (*i*) a higher number of participants contributing to the public good; (*ii*) an increase in the amount contributed by those who already contributed at the baseline. To disentangle these effects, Table 3 presents a robustness check based on two additional OLS analyses using *Amount* as the dependent variable.

To isolate the treatment effect on the size of the contributions from the potential increase in the number of donors, we use a restricted sample of 300 observations that excludes children who contributed nothing at baseline. Table 3, column 1, shows that the coefficient of the interaction term, *Treatment · Period· Low-SES* is 0.171 and statistically significant at the 5% level. This indicates that the treatment increases the resources allocated to the public good by approximately 17 percentage points among children from low socio-economic backgrounds who contributed at baseline.

Finally, to separately measure the increase in contribution amounts among high- and low-SES students based on their baseline contributive behavior, we use the full sample, as shown in column 2 of Table 3. In this specification, the *Treatment · Period* variable is interacted not only with the student's socio-economic status, but also with a dummy indicating whether the student contributed at baseline. Specifically, we use two complementary indicators of children behavior: *Sharing*, which takes value 1 if children donated at least one slice of pizza at baseline (the dependent variable of the probit model in Table 2); *NOSharing*, which takes value 1 if children did not contribute anything at baseline. This approach enables us to enhance the robustness of our findings and to jointly estimate both the intensive and extensive margins in

Table 3
Robustness check.

Variables	(1) Amount restricted sample	(2) Amount full sample
Treatment·Period·Low-SES	0.171**	
	(0.062)	
Treatment·Period·High-SES	0.018	
	(0.064)	
Treatment·Period·Low-SES·Sharing		0.159***
		(0.043)
Treatment·Period·Low-SES·NOsharing		0.155*
		(0.087)
Treatment·Period·High-SES·Sharing		0.014
		(0.068)
Treatment·Period·High-SES·NOsharing		0.029
		(0.066)
Other controls	YES	YES
School fixed effects	YES	YES
Observations	300	470

Notes: Robust standard errors clustered at the class level in parentheses.
* Significance at 10%.
** Significance at 5%.
*** Significance at 1%.

a single, high-powered regression. The results show that, while for high-SES students the treatment effects are not statistically significant in any specification, for low-SES students, the treatment increases contributions by approximately 16 percentage points, regardless of their baseline contribution behavior, further confirming our hypotheses. This outcome empirically supports our prediction, indicating that the educational intervention is more effective in contexts where social norms are weaker or less established, such as those associated with low socio-economic backgrounds.

4. Concluding remarks and policy implications

This paper presents the results of an experimental program on prosocial behavior conducted with 11 year-old children in Catania, Italy. The program involved five lessons delivered by economics students, followed by group activities. Lessons focused on fostering social responsibility, sustainable consumption, and environmental awareness.

The findings suggest that the educational program significantly increases both the likelihood of participation and the level of contributions to the public good, particularly among students from low socio-economic backgrounds. These results underline the importance of public education not only in shaping and transmitting social norms but also in developing long-lasting behavioral changes that persist even in the absence of rational incentives or explicit sanctions, in line with the habitual behavior hypothesis (Bicchieri & Dimant, 2022). In this respect, public education contributes not only to the creation of *human* capital but also to the development of the *social* capital necessary for the success of any society (Coleman, 1988). Active learning methods are a powerful tool for promoting prosocial behavior and achieving broader social goals. Educational policies, therefore, should encourage the development of cooperative and social values, creating an environment that promotes active participation in public goods without the need for external sanctions or impositions.

We acknowledge the limitations of the experiment presented. The design of the educational program prevents us from identifying which specific aspects have the greatest impact on student behavior. We also recognize the lack of a benchmark comparing lessons conducted by adult teachers, which would help assess whether the lessons delivered by young economics students are more effective. We speculate, though, that undergraduate students as instructors may offer several advantages. The main aspect is the age proximity between the instructors and the audience, which facilitates the relational aspects compared to interactions with adult teachers. The school psychology literature suggests that middle school students are more peer-oriented and look at young adults as models to emulate (Hargreaves, 2000; Lynch & Cicchetti, 1997). Further research could address these limitations by incorporating a control group with adult instructors, as well as exploring the psychological processes that drive the observed behavioral changes. In addition, from the results presented, the effectiveness of the program appears to be influenced by the children's socioeconomic status. This may suggest that promoting prosocial attitudes among high-SES children may require a different approach. Future studies could design different educational patterns tailored to children's specific background. This would help deepen our understanding of the mechanisms at play and provide more insights into the relative effectiveness of different teaching approaches in promoting prosocial behavior.

Finally, as reported from the descriptive statistics, half of the sample has less than 25 books at home. This indicator reflects the socio-economic context of the study population, such as that of Southern Italy. While this feature may constrain the external generalizability of our findings to higher-education areas, it strengthens the validity of our experiment in low-education-low-income territorial contexts where interventions aimed at promoting prosocial behavior and educational engagement are most needed and have the potential to deliver larger social benefits.

CRediT authorship contribution statement

Maurizio Caserta: Writing – review & editing, Writing – original draft, Project administration, Formal analysis. **Rosaria Distefano:** Writing – review & editing, Writing – original draft, Project administration, Formal analysis. **Livio Ferrante:** Writing – review & editing, Writing – original draft, Project administration, Formal analysis. **Francesco Reito:** Writing – review & editing, Writing – original draft, Project administration, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

In order to test children's prosocial behavior in a PGG setting, students were exposed to the following question (see Fig. A.1):

First meeting — Responsible consumption

The goal of this meeting is stimulating students' reflection on what it means to make conscious choices between needs and desires, while also involving them in a practical exercise of collaboration and role application.

Materials Used:

• PowerPoint presentations.

• Paper, markers, and other drawing materials.

Part 1: Lecture and discussion (30 min)

The speakers introduce the difference among primary needs (e.g., water), secondary needs (e.g., healthcare), and desires (e.g., PlayStation) using images in PowerPoint presentations. Students are called to discuss and reflect on the differences between needs and desires.

Part 2: Group Activity — Backpacking for a beach trip (40 min)

Students are divided into groups of four or five with each member assigned a specific role: the moderator, who would guide the discussion; the scribe, responsible for noting down the group's decisions; the presenters, who would present the final decisions to the class. Each group is tasked with selecting five items for a beach trip from a list of 20 and drawing the items chosen on a poster.

Phase 3: Presentations and Evaluation (30 min)

Each group presents its poster, justifying the choices made based on the difference between needs and desires. Groups self-assess their performance with a rating from one to ten in terms of collaboration and role adherence, while the rest of the class evaluates each work presented for creativity. The group with the highest score in each category wins a small prize (reusable bottles) for the effort and quality of the work done.

Second meeting — Sustainable environmental education

The second meeting aimed at raising students' awareness about environmental issues.

Materials Used:

• Informational sheets from *Environmental Science Journal for Teens* and *Zanichelli*.

• Paper, markers, and other drawing materials.

Part 1: Lecture and discussion (30 min)

The speakers introduce three main environmental topics to be discussed:

1. Water as a resource: The importance of water, its scarcity, and pollution issues.

Immagina di andare in pizzeria un sabato sera. Ti vengono portate 3 fette di pizza. Puoi decidere se tenere tutte le tre fette di pizza per te o se condividerle con altre persone mettendole in un piatto comune. Seleziona con una crocetta la lettera corrispondente al numero di fette che vuoi tenere e quelle che vuoi condividere.

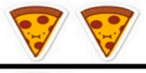
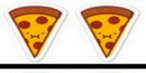
	Pizza per te	Pizza da condividere
A)		0
B)		
C)		
D)	0	

Fig. A.1. Public Good Game Matrix presented to students.

2. Environmental impact of food choices: How food production and consumption affect the environment.
3. Plastic pollution: The damage caused by plastic to ecosystems.
4. Sustainable transportation: The importance of choosing transportation options that are environmentally friendly, energy-efficient, and promote social equity.

The students are asked to reflect and discuss on ways to reduce their environmental impact, considering topics like water usage, sustainable food choices, and transportation.

Part 2: Group Activity — Creating a Flyer (40 min)

Students are divided into groups of four or five with each member assigned the same role as in the previous meeting. Each group designs and illustrate a flyer that includes guidelines for sustainable behaviors, such as use alternatives to plastic (e.g., reusable bottles, glass bottles), choose eco-friendly transportation options (e.g., bicycles, public transport).

Phase 3: Presentations and Evaluation (30 min)

Each group presents the flyer realized to the class, explaining the sustainable behaviors represented. Groups self-assess their performance with a rating from one to ten in terms of collaboration and role adherence, while the rest of the class evaluates each work presented for creativity. The group with the highest score in each category wins a small prize (reusable bags) for the effort and quality of the work done.

Third meeting — Recycling and circular economy

The third meeting aims to increase students' understanding of the importance of recycling and the circular economy.

Materials Used:

• YouTube video: https://youtu.be/GBemZPD2XA8v
• Recycled materials: bottles of various sizes, plastic/cork caps, buttons, toilet paper rolls, fabric, cardboard boxes, cans.
• Paper, colored markers, glue and other drawing materials.

Part 1: Lecture and discussion (30 min)

The speakers introduce the concept of circular economy and the importance of recycling and its environmental benefits, such us reducing waste, save resources, and minimize pollution and carbon emissions.

Part 2: Group Activity — Realizing a recycled product (40 min)

Students are divided into groups of four or five with each member assigned a specific role: the engineers, who would select the materials and give advice on how to combine them; the builders, responsible for assembling the recycled materials and realize the object. Each group is tasked with realizing a product with the recycled materials provided by the speakers.

Phase 3: Presentations and Evaluation (30 min)

Each group presents the product realized, justifying the choices of the materials used. Groups self-assess their performance with a rating from one to ten in terms of collaboration and role adherence, while the rest of the class evaluates each work presented for creativity. The group with the highest score in each category wins a small prize (ecological notebooks) for the effort and quality of the work done.

Fourth meeting — Responsible resource use

The goal of this meeting is to engage students in understanding the importance of hard work, planning, and responsible resource use.

Materials Used:

• PowerPoint presentations.
• Paper, markers, and other drawing materials.

Part 1: Lecture and discussion (30 min)

The speakers read "*The Ant and the Grasshopper*" aloud to the class and then discuss the main themes of the fable, emphasizing the contrast between the ant's diligence and the grasshopper's shirking behavior, and stressing the importance of planning and working hard to ensure future well-being.

Part 2: Group Activity — "The Ant and the Grasshopper" cartoon (40 min)

Students are divided into groups of four or five with each member assigned a specific role: the drawer, responsible for illustrating a sequence from the fable; the scribe, responsible for writing the dialogues; the presenters, who would present the final cartoon to the class. Each group is tasked with drawing a sequence from the fable as a cartoon on a poster

Phase 3: Presentations and Evaluation (30 min)

Each group presents its poster, explaining the importance of the sequence represented and the consequent moral lessons. Groups self-assess their performance with a rating from one to ten in terms of collaboration and role adherence, while the rest of the class evaluates each work presented for creativity. The group with the highest score in each category wins a small prize (a box of plantable pencils) for the effort and quality of the work done.

Fifth meeting — Solidarity and common goods

The fifth and last meeting aims to encourage students to practice virtuous behaviors for collective well-being, identify challenges in managing common resources and collaboratively develop strategies to address these issues.

Materials Used:

• PowerPoint presentation.

• Paper, markers, and other drawing materials.

Part 1: Lecture and discussion (30 min)

The instructors will read the PowerPoint presentation aloud, incorporating challenges faced in managing these resources, such as overuse, pollution, or lack of maintenance. The presentation also includes images of the cities where the children live or have visited. This approach provides practical context to the entire educational program attended.

Part 2: Group Activity — Problem Solving (40 min)

Students are divided into groups of four or five with each member assigned a specific role: the drawer, responsible for illustrating the activity; the scribe, responsible for writing the problems; the presenters, who would present the final poster to the class. Each group is assigned a specific common resource (e.g., a public park, water supply, or community garden). Then groups are asked to identify and list potential problems related to the management of their assigned resource, draw them on a poster and formulate strategies to address the problems identified.

Phase 3: Presentations and Evaluation (30 min)

Each group presents its poster, explaining the problem represented and the strategies chosen to address it, highlighting the expected benefits. Groups self-assess their performance with a rating from one to ten in terms of collaboration and role adherence, while the rest of the class evaluates each work presented for creativity. The group with the highest score in each category wins a small prize (sustainable sticky notes) for the effort and quality of the work done.

Appendix B. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.socec.2025.102400.

Data availability

Data will be made available on request.

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