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Can school environmental education programs make children and parents more pro-environmental?

Marcela Jaime [a], César Salazar [b,*], Francisco Alpizar [c], Fredrik Carlsson [d]

[a] Escuela de Administración y Negocios, University of Concepción; Research Nucleus on Environmental and Natural Resource Economics (NENRE EfD-Chile) and Center of Applied Ecology and Sustainability (CAPES), Chile

[b] Departamento de Gestión Empresarial, Facultad de Ciencias Empresariales, University of Bío-Bío; Research Nucleus on Environmental and Natural Resource Economics (NENRE EfD-Chile); Centro de Estudios de Ñuble and Interdisciplinary Center for Aquaculture Research (INCAR), Chile

[c] Environmental and Natural Resource Economics Group, Department of Social Sciences, Wageningen University and Research, the Netherlands

[d] Department of Economics, University of Gothenburg, Sweden and Center for Collective Action Research (CeCAR) at University of Gothenburg, Sweden

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ABSTRACT

We evaluate the direct and indirect effects of an environmental educational program with value-laded content on children's and parents' knowledge, attitudes and practices regarding the consumption and disposal of plastics.We do this using a randomized field experiment targeting fourth-grade children in Chile.The educational program had a sizeable and a positive impact on children' knowledge, attitudes, and practices, but no effect on parents' behavior.Heterogeneous effects indicate that the program had a larger effect among children in more vulnerable schools, but there was still no effect on parents.Finally, because parents may ultimately determine what constitutes acceptable behavior for children, promoting permanent changes in behavior will require interventions of this sort to be complemented with other initiatives targeting parents.

1. Introduction

For many environmental problems, changing people's attitudes and norms—and the resulting behavioral changes—is an important first step in addressing the problem.This is particularly important in settings where there are limited possibilities to use standard policy instruments, like when actions are not easily observable.While how to best affect attitudes and norms is not straightforward, we do know that the process of forming attitudes and norms starts at a young age and that experiences and education are likely to shape us as human beings.

In this paper we investigate the direct and indirect effects of an environmental education campaign targeting 9 to 10-year-old school children on pro-environmental attitudes and behavior.The target audience of this campaign is school children, but we incorporate the children's parents/guardians as a secondary object of study.Children develop pro-social and altruistic preferences at a rather young age (Fehr et al., 2013; Sutter et al., 2019), exhibiting pro-environmental preferences and behavior of their own (Dewey, 2021; Grønhøj and Thøgersen, 2009).There is also evidence that these types of preferences can be affected by various interventions (Bettinger and Slonim, 2006; Kosse et al., 2020).There are abundant examples of research that evaluates educational campaigns on students' academic performance (e.g., Angrist et al., 2002), but our focus is not on test performance.Instead, we look at actual attitudes and practices related to pro-environmental behavior, and how those attitudes and practices are affected by knowledge about environmental problems.

The first contribution of this paper is that we experimentally test how an environmental education campaign with value-laden content affects school children's knowledge, attitudes, and practices (hereinafter KAP) regarding the use and handling of plastic products.We do this by implementing a comprehensive environmental education campaign in a sample group of schools and measuring KAP before and after treatment in both the treated and control schools.We extend the mainly laboratory experimental work on pro-social behavior among children (see, e.g., Harbaugh and Krause 2000; Sutter et al., 2019) by conducting a field experiment on how to affect pro-environmental behavior.There are a

* Corresponding author.
E-mail addresses: mjaime@udec.cl (M. Jaime), csalazar@ubiobio.cl (C. Salazar), francisco.alpizar@wur.nl (F. Alpizar), fredrik.carlsson@economics.gu.se (F. Carlsson).

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number of studies on the effects of information and education on pro-environmental behavior (Hartley et al., 2015, 2018; Hoang and Kato, 2016; Owens, 2018).These are often evaluations of smaller campaigns and are primarily comparisons of behavior and attitudes before and after, without a proper counterfactual.Our experimental evaluation is therefore an important contribution to understanding the effect of environmental education on pro-social preferences.

Second, our intervention is novel in that it links the environmental education campaign with a strong appeal to personal norms.Normative information has been proved to generate a larger impact on pro-environmental behavior, compared with plane information provision (Huber et al., 2018; De Groot et al., 2013; Viscusi et al., 2011).Particularly, personal norms appear to be more suitable to promote pro-environmental behavior when dealing with unobserved individual actions such as plastic pollution (De Groot et al., 2021).Our experiment is a value-laden education campaign targeting parents and children. Since society is in agreement regarding the need to reduce the flow of plastics into the ocean, we could safely include a very salient injunctive norm of behavior (Jambeck et al., 2015).

Third, our experimental design allows us to investigate the potential heterogeneity of the treatment effect according to different school characteristics, thus capturing inequality of opportunities at an early age.There are several experimental studies supporting the heterogeneous effects of informational and educational campaigns on educational outcomes when accounting for the initial conditions and socioeconomic background, with mixed results (McGuigan et al., 2016; Avitabile and de Hoyos, 2018; Bonilla-Mejía et al., 2019).However, these experiments were not directly designed to evaluate any of these characteristics, which means that their results are only suggestive.The Chilean education system offers an interesting setting to test the heterogeneous effects of school type.In this system, parents and guardians are free to choose the school their child will attend.There are two types of schools: public schools, which are funded entirely by the government, and private and semiprivate schools, which are privately funded.As this latter option involves payment on the part of the parent/guardian, it is often the choice of wealthier families.This system has been shown to generate a profound socioeconomic stratification in educational achievement and inequality (Torche, 2005; Mizala and Torche, 2012; Zancajo, 2019).

The fourth contribution of this paper is that we investigate if there is any transfer in KAP from school children to their parents.We do this by also measuring the KAP of the parents before and after the educational campaign in both the treated and control schools.Intergenerational transmission of preferences has been investigated extensively in areas such as human capital (Black et al., 2005), generosity (Wilhelm et al., 2008), happiness (Carlsson et al., 2014), risk and trust (Dohmen et al., 2012) and pro-environmental behavior (Grønhøj and Thøgersen, 2009; Leppänen et al., 2012; Meeusen, 2014; Casaló and Escario, 2016; Collado et al., 2017).The focus of that literature, though, has been on the transmission of preferences from parents to children.For example, literature on pro-environmental behavior supports a positive correlation between children's and parents' environmental behavior (Grønhøj and Thøgersen, 2009; Matthies et al., 2012).However, in the case of educating children, the direction of the effect could be the opposite, where the knowledge learned by children could change the values and beliefs of their parents (Duvall and Zint, 2007).Environmental education programs directed at children may promote transfer of environmental knowledge, attitudes, and behavior to adults (e.g., Ekström, 2007; Grønhøj, 2006; Lawson et al., 2018; Williams et al., 2017; Boudet et al., 2016; Maddox et al., 2011; Larsson et al., 2010).Our experimental design allows us to test the hypothesis of whether preferences are being transferred from children to parents.

The educational program we implemented is an environmental education module.Our intervention is adapted from the content and curricula of the National Oceanic and Atmospheric Administration (NOAA) marine debris program (NOAA, 2015).Marine debris is a global issue that negatively impacts oceans, wildlife and potentially humans. One important contributor to marine debris is the use of single-use plastics, which are used not only by adults in daily activities but also by children, for example in the packaging of their lunchboxes.The contents of the program was reinforced with messages, activities and homework that appeal to personal norms.We hypothesize that by being exposed to personal normative information, children will develop personal values towards the importance of reducing marine debris, and thus, the program will not only increase their knowledge in this subject, but also generate changes in behavior, measured by attitudes and practices regarding consumption and disposal of plastics.

Homework was designed to involve the parents, indirectly making them aware of the program.This program was implemented at a set of schools in central-southern Chile.To account for the behavior of children and parents at home before and after the intervention, we implemented *ex-ante* and *ex-post* surveys for both children and parents.The set of control schools, chosen as a matched sample of the treated schools, was only visited twice to gather the *ex-ante* and *ex-post* KAP measurements.

We find that this program had a positive and sizeable effect on children's knowledge, attitudes, and practices.Results are robust to unmatched regressions, and when accounting for unanticipated events like social unrest in Chile and COVID-19.Thus, our results clearly show that educational campaigns and other types of interventions can affect pro-environmental preferences (Grodzinska-Jurczak et al., 2003; Bettinger and Slonim, 2006; Duvall and Zint, 2007; Hartley et al., 2015; Boudet et al., 2016; Hoang and Kato, 2016).We also find that the effect of the intervention was even larger among children attending public schools, meaning the program promoted pro-environmental behavior among children in more disadvantageous economic situations.

However, we do not find any evidence of a spillover effect on the parents' attitudes, knowledge, or practices.Results from previous studies on intergenerational transmission of environmental education programs reveal mixed results, although most studies have found a positive effect. Leeming et al.(1997) evaluated the Caretaker Classroom Program in schools in the US and found that the program positively and significantly affected students' attitudes toward the environment.Parents indirectly influenced by their children's activities in the program also displayed more pro-environmental behavior.A positive effect on parents' attitudes and behavior has been found in a few previous other studies as well (see, e.g., Ballantyne et al., 2001; Vaughan et al., 2003).More recently, Singh et al.(2020) evaluated an environmental education program called "The Green Schools Program" in twelve schools in India.They found no significant impact of the program on parents' environmental perceptions. Thus, our results on spillover effects are not in line with the majority of previous studies.

The rest of the paper is organized as follows.Sections 2 presents the experimental design in detail.The empirical strategy is presented in section 3.Main results are presented in section 4, and in section 5 we report results from a set of robustness checks.Finally, section 6 provides the main conclusions and policy recommendations.

The data and code for reproducing all analyses in this study are available at the project's Open Science Framework page: https://osf.io/ [to be made public upon publication].

2. Experimental design

The experimental design and pre-analysis plan were formally registered with the American Economic Association's registry for randomized controlled trials (AEARCTR-0004650) and formally approved on August 30, 2019.Our experimental design strictly followed the methodology and activities stated in the Pre-analysis Plan, which was registered prior to the start of data collection.

2.1. Description of the sample

The study took place in central-southern Chile, in the Biobío Region.

The intervention was conducted in partnership with the Sustainable School Program, led by the regional office of the Ministry of the Environment.[1] From a total of 205 schools, we were able to find suitable matching options for 27 schools based on the following observables: (i) public and private schools, (ii) low- and high-income schools, (iii) coastal and non-coastal towns, and (iv) schools with low- and high-levels of environmental commitment based on their performance in the Sustainable School Program.This matching process allows us to reduce the extensive heterogeneity among schools.Of the 27 matched schools, a total of 14 were assigned to the treatment group, while the remaining 13 schools were assigned to the control group.[2]All fourth-grade students in each school were surveyed, resulting in 1058 students and 840 parents/guardians.[3] The planned distribution of the schools is presented in Table A1, in Appendix A.[4]

2.2. The environmental education module

Our experiment involved providing an environmental education program with value-laden content.The program was adapted from content in the educators' guide to marine debris, designed by the North American Marine Environment Protection Association in partnership with the National Oceanic and Atmospheric Administration (NOAA). This guide is based on NOAA's Turning the Tide on Trash: A Learning Guide on Marine Debris (NOAA, 2015).The intervention included three modules, and each module was covered in two lessons.The activities were adapted to the Chilean context when necessary (e.g., endangered species, locations).The lessons took place in the classroom, and the contents were taught by a certified teacher and a support team that kept detailed records of the lecture in terms of attendance and participation.[5] The duration of each lesson was 90 min.Lessons were administered biweekly, with 6 lessons in total.In order to target the children directly and parents/guardians indirectly, the lessons were coupled with homework and activities that involved parent interaction (e.g., counting the number of single-use plastics in the home, counting, and sorting the number of single-use plastics that are used during the week).Parents never received information directly from us or the school, allowing us to isolate the transmission of information from children to parents.The value-laden content of the environmental education program consisted of personal normative messages in the lecture material and the activities, which were aimed at incentivizing personal norms of avoiding single-use plastics.Avoiding single-use plastics has been proven to generate a larger impact on plastic consumption and waste separation by making salient that both the cause and consequence of marine plastic pollution problem has its root in individual behavior (Alpizar et al., 2020; Xu et al., 2018; Willman, 2015; Jakovcevic et al., 2014; Convery et al., 2007).

2.3. Measuring outcomes and hypotheses

Outcome measures are based on the *ex-ante* and *ex-post* surveys given to both children and parents.Data collection occurred in 2019, with ex-ante data gathered between March and May and ex-post surveys conducted during September and December.Since we focus on both direct and spillover effects of the program, these surveys were administered to both children and parents in the treatment and control schools.Children were given the survey in the classroom by a team of enumerators, so that parents had no direct influence on how kids responded.Parent/guardian surveys were sent through the communication portfolio, which is the official communication tool used between parents and teachers.It is worth mentioning, however, that parents' involvement was voluntary.

The survey instrument consisted of three modules: (1) Knowledge, (2) Attitudes, and (3) Practices (KAP).[6] The knowledge module of the questionnaire mirrored the pre-survey instrument designed by Ocean Conservancy and NOAA Marine Debris (NOAA, 2017).The attitudes and practices modules, on the other hand, were a combination of both existing survey questionnaires (Eurobarometer, 2019) and questions that we constructed.The survey instrument to the parents included an additional module intended to measure their general involvement in their children's education.[7]

We define children's and parents' *knowledge* about plastic pollution as the percentage of correct answers on a list of 11 questions.The measure of *attitudes* regarding plastic pollution is computed as an *index of concern* following the procedure in Boudet et al.(2016).We use respondents' concerns regarding the presence of inland and ocean trash as one of main environmental problems in their town of residence and their stated importance of avoiding the use of plastic bags and straws on a daily basis.An increase in the index indicates a more pro-environmental attitude.*Practices* regarding consumption of plastic are measured in two ways: with an *index of avoidance of plastic* and with a *lunch-box* index (Boudet et al., 2016).The first index relates to how often individuals avoid using plastic straws, plastic cups, plastic vegetable wrap, plastic bottles, and plastic bags on a daily basis.We constructed it in a similar way as in the Protecting the Environment – Eurobarometer survey (Eurobarometer, 2019).An increase in the index indicates that children/parents more frequently avoid using plastics.The second index accounts for the items included in the child's lunch box.An increase in the index indicates children and parents pack children's food for school using reusable containers.Finally, practices regarding disposal of plastics are measured through an *index of recycling,* including information on the separation of plastic waste, the use of a special container to recycle, and membership in recycling groups.Higher scores in this index imply a greater effort toward recycling plastic.

Our three main hypotheses are that (i) the educational program directly affects children's knowledge, attitudes and practices regarding the consumption and disposal of plastic; (ii) the educational program targeting children has indirect effects on parents'/guardians' knowledge, attitudes and practices regarding the consumption and disposal of plastic; and (iii) the magnitude of the effect on children and parents is determined by observable school characteristics.

[1] The Sustainable School Program is a comprehensive strategy for environmental and sustainability education in educational establishments throughout the country, from early childhood education to secondary education.It is a voluntary system that gives a public certificate to the schools that successfully implement strategies for environmental education.

[2] Before the intervention, we calculated the minimum detectable effect of the intervention.Because measures of knowledge and attitudes regarding plastic pollution were unknown, we focused on practices.We used information from the Chilean National Survey of the Environment carried out in 2018; however, this survey only contains minimal information on plastic disposal practices. These figures indicate that, in the Biobio region, 44% of individuals separate plastics for recycling.Assuming a statistical power of 80% and without repetition, the minimum detectable effect for an estimated sample of 1320 students was 7%.

[3] Because parents' participation is voluntary, the number of observations is larger for children.

[4] There were three schools in the original plan ($n = 1320$) that refused to participate.They were mainly private and control schools, arguing that they did not see major benefits from participating.We replaced these schools with the most similar ones, based on the observable characteristics that were used as selection criteria.Thus, the final sample comprises 1058 students.

[5] This team was hired to implement the program across participant schools. This allowed us not only to guarantee a standardized implementation of the program, but also ameliorating the effect of potential characteristics of different teachers that could mediate the way children perceived the program, and their subsequent learning and behavior.

[6] For a systematic review of studies identifying and using the KAP model for sustainability issues, see Salas-Zapata et al.(2018).

[7] The survey is available upon request.

Table 1
Pre-treatment KAP variables.

	Students					Parents				
	All	Treatment	Control	Diff.	p-value	All	Treatment	Control	Diff.	p-value
Knowledge	0.583 (0.140)	0.576 (0.147)	0.591 (0.132)	−0.015	0.613	0.741 (0.109)	0.751 (0.108)	0.729 (0.111)	0.022	0.474
Attitudes	0.801 (0.198)	0.789 (0.199)	0.814 (0.197)	−0.025	0.314	0.846 (0.179)	0.841 (0.185)	0.853 (0.170)	−0.012	0.640
Lunch box	0.475 (0.344)	0.458 (0.325)	0.495 (0.365)	−0.037	0.232	0.439 (0.358)	0.443 (0.345)	0.433 (0.374)	0.011	0.764
Consumption	0.569 (0.215)	0.575 (0.217)	0.561 (0.217)	0.014	0.651	0.631 (0.215)	0.644 (0.210)	0.613 (0.221)	0.031	0.372
Recycling	0.475 (0.281)	0.476 (0.277)	0.474 (0.277)	0.002	0.946	0.344 (0.292)	0.353 (0.297)	0.330 (0.285)	0.023	0.489
No.Obs	1058	557	501			840	479	361		

Note: own calculations based on pre-treatment information.Standard deviations in parentheses.Statistical inference is based on a two-sample test for proportions.

Table 2
Descriptive statistics of households and parents' characteristics.

Variable	All	Treatment	Control	Diff.	*p*-value ($p_1 = p_2$)	*p*-value ($\sigma_1^2 = \sigma_2^2$)	*p*-value ($\sigma_1^2 \neq \sigma_2^2$)
Parents/guardian's characteristics							
Age of guardian [*years*]	38.5 (7.230)	38.7 (7.086)	38.2 (7.426)	0.42	–	0.428	0.432
Mother's formal education [*years*]	12.7 (3.241)	13.4 (3.178)	11.9 (3.130)	1.49	–	0.000	0.000
Father's formal education [*years*]	12.6 (3.623)	13.5 (3.620)	11.5 (3.316)	1.95	–	0.000	0.000
Children living with both parents [%]	0.687 (0.464)	0.699 (0.459)	0.670 (0.471)	0.029	0.369	0.370	0.372
Households' characteristics							
Households' income [*CLP$/month*]	670,833 (601,227)	822,357 (709,772)	474,286 (330,445)	348,071	–	0.000	0.000
Household size [No.]	4.5 (1.336)	4.4 (1.275)	4.5 (1.412)	−0.12	–	0.199	0.205
No.Obs	840	479	361				

Note: Own calculations based on ex-ante data.Standard deviations in parentheses.Test of differences in baseline characteristics based on two tests: a test of difference in proportions, which was applied to variables represented in shares/proportions, and a *t*-test (for both equal and different sample variances) that was applied to continuous variables.

2.4. Baseline characteristics

A summary of the baseline characteristics of the outcomes of interest are presented in Table 1.

There are no statistically significant differences among the KAP outcomes between the treatment and control groups for children or parents.The knowledge index suggests that children are familiar with the marine plastic pollution problem, with an average of 58% correct answers.Parents/guardians are more knowledgeable than children, with an average of 74% correct answers.Notwithstanding the positive rate of correct responses, both children and parents were not very familiar with important issues such as the main cause of marine debris, who is affected by this problem, the meaning of waste degradation and the time needed for some plastic items to degrade.

Regarding attitudes, both children and parents share similar concerns for the plastic pollution problem.Children and parents are more concerned about the presence of ocean and inland trash than with the use of plastic bags and straws.Similarly, both children and parents exhibit similar behaviors in terms of consumption practices.The most important consumption practices among children are avoiding food wrapping, plastic bags and plastic bottles, practices that are also shared by parents.Finally, there is a lack of recycling practices by both children and parents.More information regarding the components of the indexes, the survey questions from which they were computed, and a summary of the distribution of responses by treatment status are available in Figures A1-A4, Appendix A.

Table 2 reports the descriptive statistics of the main variables describing the socio-economic characteristics of households.

Around 69% of children live with both parents.The average age of the parent/guardian is 38 years, and households have, on average, four family members.There are no statistically significant differences between the treatment and control group regarding these characteristics.[8]

However, there are statistically significant differences between the treatment and control group with respect to parents' years of education and household income.Because these factors did not affect the pre-treatment balancing of the outcomes of interest, but rather the balancing of control characteristics, we believe this situation does not prevent us from estimating a casual effect of the environmental education program.We will, however, account for these differences as a robustness check.

Because the school system in Chile is highly heterogeneous in terms of socio-economic background of students, these differences could also determine school choice about incorporating the study of environmental problems into their curricula.Table A2 in Appendix A presents pre-treatment KAP scores for public and private schools separately, regardless of the treatment status.There are statistically significant differences in the pre-treatment levels of consumption and disposal practices between public and private schools.However, there are no statistically significant differences in our outcomes of interest between students and parents in the treatment and control groups for either public or private schools, as shown in Tables A3-A4.

As previously mentioned, educational opportunities for children in the Chilean school system often rely on the socio-economic status of the child's household.Table A5 displays socioeconomic characteristics of households by school type, regardless of the treatment status.Parents whose children attend private schools are, on average, older, more educated, and wealthier than those whose children attend public schools.These differences persist even after adjusting *p*-values with a Bonferroni correction.

To conclude, Table A6 displays differences in pre-treatment characteristics of public and private schools when considering the treatment status.There are statistically significant differences in terms of socio-economic characteristics.These differences are more profound for private schools.Even though our main outcomes of interest are not different in the baseline, differences in observable covariates will be accounted for in our empirical strategy to ensure a clear identification of effects when assessing the impacts of the educational program.

[8] Statistical inference is based on two tests: a test of difference in proportions, which was applied to variables represented in shares/proportions, and a *t*-test (for both equal and different sample variances), which was applied to the continuous variables.

Table 3
Homogeneous treatment effects of the environmental education program on school children (Matched sample).

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.053***	0.075***	0.127***	0.075**	0.068**
	(0.016)	(0.022)	(0.036)	(0.025)	(0.023)
Post-treatment	0.050**	−0.02	−0.018	−0.006	−0.028
	(0.012)	(0.018)	(0.031)	(0.016)	(0.015)
Constant	0.584***	0.809***	0.481***	0.576***	0.485***
	(0.004)	(0.005)	(0.009)	(0.006)	(0.006)
No.Observations	1576	1515	1509	1517	1543
No.Individuals	788	786	782	787	788
Adjusted R^2	0.203	0.028	0.038	0.036	0.011
F-test	62.67	10.63	19.29	6.22	4.52

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (School level).*P*-values are Bonferroni corrected for multiple hypothesis testing. Variables included in the matching: School dependence, income, mothers' education and fathers' education.

Table 4
Homogeneous treatment effects of the environmental education program on parents (Matched sample).

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.01	0.009	0.064	−0.011	0.012
	(0.010)	(0.016)	(0.035)	(0.0120)	(0.023)
Post-treatment	−0.015	−0.003	−0.018	0.016	0.019
	(0.009)	(0.013)	(0.030)	(0.016)	(0.018)
Constant	0.696***	0.851***	0.452***	0.638***	0.357***
	(0.003)	(0.004)	(0.008)	(0.005)	(0.006)
No.Observations	1372	1308	1309	1295	1326
No.Individuals	686	682	677	683	683
Adjusted R^2	0.006	−0.001	0.008	0.002	0.009
F-test	1.46	0.23	3.35	0.62	3.10

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (Household level).*P*-values are Bonferroni corrected for multiple hypothesis testing. Variables included in the matching: School dependence, income, mothers' education and fathers' education.

3. Empirical strategy

The empirical strategy of this study is based on reduced form specifications.The estimate of interest is the Average Treatment Effect (ATE) in the population of children/parents enrolled in schools participating in our program.The ATE is the expected effect of the treatment on a randomly selected individual from the population and is defined as $\alpha = E[y^1_{it} - y^0_{it}]$, where y^1_{it} and y^0_{it} are the potential outcomes for child/parent *i*'s behavior regarding plastic consumption and disposal before and after the intervention, whether the school was treated or not with the environmental education program, respectively.Note that for every subject, only one of those outcomes is observable, but randomization into treatment and control groups allows us to estimate the ATE by means of the equations below (Wooldridge, 2010; Blundell and Costa, 2009).

3.1. Homogenous treatment effects

We are interested in two main effects: (1) *Direct effects* of the program on children's behavior, and (2) *indirect effects* of the program on parents' behavior.The specification consists of the difference-in-differences estimator, in which the outcome is given by:

$$y_{it} = \alpha T_i P_{it} + \beta P_{it} + v_i + \varepsilon_{it}, \quad (1)$$

where y_{it} denotes child/parent *i*'s outcome of interest in period *t*; T_i is a treatment status indicator that is equal to 1 if the school was targeted by the program and 0 otherwise; P_{it} is a post-treatment indicator that is equal to 1 after the intervention, and 0 otherwise; v_i are children's/parents' fixed effects; and ε_{it} is the error term.To account for existing pre-treatment differences in observable characteristics, we identify a matched sample that is comparable in terms of the socio-economic characteristics of the child's household (i.e., type of school, parents' education, and household income).[9] The identification strategy follows the procedure described by Imbens et al.(2009).In the first stage, using data from the ex-ante survey, we estimate propensity scores for each household using a probit model.After dropping the observations that fall outside the common support, children are matched based on the propensity scores.Equation (1) is then estimated on the matched sample by means of weighted regressions, in which comparison observations are weighted based on the number of times they were included as matches.[10] Provided a suitable performance of the matching, the direct effect of the educational program is consistently estimated by the parameter α.Standard errors are clustered at the school level when investigating the children's behavior and at the child/household level when investigating the parents' behavior.

Moreover, because the assessment of the intervention relies on

[9] Observed differences in socio-economic characteristics may be due to changes in the initial experimental design: (*i*) some private schools denied participation in the program and had to be replaced; (*ii*) there were a few children and parents who did not provide responses in the second round of the survey; and (*iii*) three schools opted out of the program in response to a social unrest and COVID-19 pandemic.As stated in the pre-analysis plan (and its supplements), because of the COVID-19 pandemic, schools in Chile had only one week of face-to-face lectures during the whole 2020 academic year.The academic year starts the second week of March, but in 2020 the Ministry of the Education of the Government of Chile cancelled face-to-face classes starting March 16.Students had virtual lessons during 2020 and 2021, returning to in person lectures in March 2022.Even though there were only two lessons left to complete the program in these three schools, we were unable to complete those lessons, and these schools were thus removed from the analysis.The effects of these unexpected events are addressed as robustness checks.

[10] We use a nearest neighbor 1–4 with replacement and a caliper of 0.01 as the matching method (Abadie et al., 2004).

Table 5
Heterogeneous treatment effects of the environmental education program on school children by school type (Matched sample).

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treat × Post-treatment × Public	0.076***	0.075**	0.155**	0.095***	0.080**
	(0.021)	(0.023)	(0.049)	(0.025)	(0.024)
Treat × Post-treatment × Private	0.054***	0.052*	0.111	0.001	−0.005
	(0.014)	(0.019)	(0.046)	(0.025)	(0.023)
Post-treatment	0.046***	−0.011	−0.021	0.024	0.014
	(0.011)	(0.014)	(0.036)	(0.017)	(0.017)
Constant	0.590***	0.811***	0.479***	0.576***	0.479***
	(0.003)	(0.004)	(0.0103)	(0.006)	(0.005)
No.Observations	1500	1404	1392	1384	1438
No.Individuals	750	702	696	692	719
Adjusted R^2	0.22	0.02	0.03	0.04	0.01
F-test	70.67	6.84	8.70	15.56	11.12

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (School level).*P*-values include are Bonferroni corrected for multiple hypothesis testing.Variables included in the matching: Income, mother's education, and father's education.

Table 6
Heterogeneous treatment effects of the environmental education program on parents by school type (Matched sample).

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treat × Post-treatment × Public	0.011	0.011	0.051	−0.062	−0.040
	(0.015)	(0.022)	(0.042)	(0.029)	(0.035)
Treat × Post-treatment × Private	−0.006	0.020	0.025	−0.034	−0.028
	(0.012)	(0.021)	(0.036)	(0.026)	(0.032)
Post-treatment	−0.002	−0.003	0.0003	0.052*	0.073**
	(0.010)	(0.016)	(0.029)	(0.022)	(0.027)
Constant	0.698***	0.851***	0.437***	0.630***	0.335***
	(0.003)	(0.004)	(0.008)	(0.006)	(0.007)
No.Observations	1314	1246	1262	1234	1280
No.Individuals	657	623	631	617	640
Adjusted R^2	0.001	0.001	0.004	0.024	0.039
F-test	0.84	0.70	1.33	2.60	5.63

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (Household level).*P*-values include are Bonferroni corrected for multiple hypothesis testing.Variables included in the matching: Income, mother's education, and father's education.

multiple outcomes, the chance of erroneously attributing statistically significant outcomes to the program increases.To tackle this problem, we provide Bonferroni-corrected *p*-values when evaluating the effect of the program.This procedure allows us to adjust the statistical significance of the estimated parameters by dividing the observed *p*-values of the estimated models by the number of comparisons made (Benjamini and Hochberg, 1995).

3.2. Heterogeneous treatment effects

As explained previously, we are interested in the difference between public and private schools.As a reminder, private schools include fully private and semi-private institutions, which are managed by private organizations.Given their reputation and status signaling, wealthier families are more likely to enroll their children in a private or semi-private school.In contrast, public schools are centrally managed by municipalities.Denoting Z_i as the potential mediator of the treatment effect, the aforementioned specification is augmented as follows:

$$y_{it} = \alpha_1 Z_{1i} T_i P_{it} + \alpha_2 Z_{2i} T_i P_{it} + \beta P_{it} + v_i + \varepsilon_{it}, \quad (2)$$

The effects of interest are captured by the parameters α_1 and α_2, which denote the marginal change in the treatment effect for the subsample of individuals who do/do not fulfill the specific condition denoted by the mediators Z_{1i} (i.e., public school) and Z_{2i} (i.e., private school).

4. Results

4.1. Homogeneous treatment effects

We begin with analyzing the direct effects of the environmental education program on the knowledge, attitudes, and practices of the children.Estimates corresponding to the primary specification given by Equation (1) are reported in Table 3.

There is a positive, sizeable, and statistically significant effect on the school children's KAP regarding the use and disposal of plastics.Note that all dependent variables are indices ranging from zero to one, so that the coefficients can be interpreted as treatment effects in percentage points.The increase in knowledge is 7.6 percentage points.Given a pre-treatment average of 0.58 for the knowledge index, this corresponds to an increase of almost 30%.There is also a sizeable effect of the education program on attitudes.Columns 3–5 of Table 3 report results for consumption and recycling practices.The effects range between 7 and 11 percentage points, which correspond to effects between 13% and 25% when compared to the pre-treatment levels.Thus, the school children in the treatment groups not only increase their efforts to reduce the use of plastics in their lunchboxes, but they also change their behavior in general.Moreover, they increase their recycling practices.By taking consumption and disposal practices altogether, results thus support our first hypothesis.

Next, we look at the potential indirect effects of the education program on parents.Results are presented in Table 4.

There are no statistically significant effects on knowledge, attitudes, or practices among the parents.Thus, for this educational program, there is no intergenerational transmission despite the sizeable changes in children's KAP and the efforts spent involving parents through homework.Thus, results do not support our second hypotheses.The absence of indirect effects of our program is in line with a minority of studies (see, e.g., Singh et al., 2020), which shed light on the difficulties of making substantial changes on behavior in adulthood when consumption habits (and preferences) are already formed.

Finally, the evaluation of the performance of the matching method indicate that this successfully addressed the problem of imbalances between groups.Consequently, the results can be interpreted as the causal effects of the environmental education program, providing evidence against the notion of estimated effects being driven by pre-treatment differences in socio-economic characteristics of the children's household.A summary of the performance of the matching procedure is depicted in Tables A7-A9 and Figure A5 in Appendix A.

4.2. *Heterogeneous treatment effects*

For school children, we now investigate if the treatment effects are different depending on the type of school: public versus private. Heterogeneous effects on children's behavior are summarized in Table 5.

The educational campaign affects children's knowledge and attitudes about plastic pollution regardless of the educational context; however, the behavior of children in public schools is relatively more influenced by the educational campaign than those of children in private schools.For this group of children, there are statistically significant effects in all dimensions of their KAP.This suggests that the environmental educational campaign has a stronger effect when directed towards more poor groups, supporting our third hypotheses. Thus, the program has the potential of producing important behavioral changes, which could incentivize the emergence of pro-environmental preferences among children belonging to families were promoting concern for the environmental is most costly.It is important to note that the results are not driven by pre-treatment differences in any of the outcomes.

We also investigate if there is an effect of the educational program on some group(s) of parents.Heterogeneous effects on parents' behavior are summarized in Table 6.

Neither parents with children in public nor private schools are affected by the education program.This is in line with the finding that there is no sign of intergenerational transmission from children to parents in the whole sample.

5. Robustness checks

In this section we investigate the robustness of our main results.We focus on two issues: (*i*) differences in pre-treatment covariates and (*ii*) unanticipated events.

5.1. *Disregarding pre-treatment differences observable characteristics*

The first concern with the treatment assignment was the presence of imbalance in some pre-treatment covariates.These differences may be due to changes in participation decisions by schools, and the presence of two unexpected events (i.e., a social unrest in the country arising from a strike, and the start of the Covid-19 pandemic).Despite the absence of statistically significant differences in the outcomes of interest, our empirical strategy relied on a matched sample of individuals to ensure a cleaner identification of effects.While the matching procedure successfully addressed the imbalance problem, it remains unclear to which extent the magnitude of our estimated effects compared with that of the original sample.To assess these differences, we estimate the specification in equations (1) and (2) for the unmatched sample of individuals, by means of the OLS estimator.A summary of the homogeneous effects of the program is presented in Tables A10-A11 (appendix A) for children and parents, respectively.Results confirm our previous findings, showing that whereas children change behavior in all KAP dimensions, parents do not react to the intervention.However, the estimated effects are larger in the main results with a matched sample.Similarly, heterogeneous effects of the program by school type are presented in Tables A12-A13.Once again, results are robust to the chosen estimation method, suggesting that the educational campaign had a larger effect on children attending public schools.

5.2. *Accounting for unanticipated events*

Following our schedule of experimental design implementation, our intervention was expected to end in December 2019.However, social unrest arising from a strike started to take place in Chile on October 18th, 2019.These unanticipated events were reported in updated versions of the Pre-Analysis Plan (PAP) (Jaime et al., 2019).This situation affected the normal functioning of the country.One of the most affected areas was the Biobio Region, where our intervention took place.The unrest affected the management of schools (e.g., lessons canceled by the educational institutions, teachers' strikes, absence of children in response to parents' concerns, etc.).Notwithstanding the difficult situation, we managed to continue implementing the program, keeping the contents and activities exactly as planned.We were able to complete the program in 14 of the 15 treated schools and to administer the second wave of surveys in 13 of the 15 control schools.Because of the social unrest, the 2019 academic year was not finished in the three remaining schools.We then rescheduled program activities in these three schools for March 16–18, 2020.On March 15th, 2020, Chile reached phase 4 of COVID-19, and on March 16th, the Chilean government closed all schools and universities in the country, preventing us from continuing with our intervention.Lessons in classrooms were not reestablished until March 2022.

Because the social unrest in Chile may have affected the learning process of children and, consequently, that of their parents, it is important to control for the potential effects of the strikes on both children's and parents' behavior in our econometric analysis.To address this, we employ two strategies as outlined in the PAP through supplementary documents that continuously updated the current situation of the experiment: First, we added an interaction term in which a dummy variable identifies schools where the program ended after the shock (i.e., 12/14 schools).Results are shown in tables A14-A15.Main findings show a negative effect of the shock on children's knowledge among schools completing the program after this unexpected event, and no statistically significant differences in parents' behavior before and after the shock. These results suggest that estimated ATEs of the intervention may have been larger in absence of this shock.

In addition, we conduct a robustness check by removing both treated and control schools that completed the program before the start of the shock (i.e., 2 treated and 1 control schools).This strategy assumes that both treated and control schools have been equally affected by the social unrest in the country.Results are presented in tables A16-A17 and are fundamentally the same as those estimated for the whole sample.

6. Conclusions

Plastic pollution is a global issue with local origins, and its consequences on marine ecosystems are potentially severe.The problem originates from the consumption and production decisions of households and businesses that rely excessively on plastic packaging (e.g., bag and containers) and plastic utensils (e.g., straws, cutlery).While improved waste management and recycling are part of the solution, reducing plastic consumption and improving disposal practices are necessary.This paper evaluates the direct and indirect effects of an environmental education program with value-laded content on children's and parents' knowledge, attitudes and practices regarding consumption and disposal of plastics.We find that the program had a positive and sizeable effect on children's knowledge, attitudes, and practices, but that it had no effects on parents' behavior.The program had a stronger effect among children in more disadvantaged economic conditions (public schools).These findings are robust to the choice of the estimation method and when accounting for unanticipated events.

This paper has several policy implications.First, our findings shed light on the effect of incentivizing pro-environmental behavior in early stages of life.Our results show that an educational campaign targeting young children can influence their value systems, which could in turn promote habits of sustainable consumption and disposal of waste.Unfortunately, our educational campaign shows no effects on parents.In order to judge the implications of this finding for the long-term impacts of such campaigns, a better understanding of parents' influence on children pro-environmental behavior is needed.If we assume that parents ultimately determine what constitutes acceptable behavior, then the lack of change in parents' attitudes and behavior sheds a negative light on the potential long-term effects of programs targeting children's value systems.To counteract this, interventions targeting children, like ours, should be reinforced in various ways.One alternative is to target children's and parents' behavior directly, while following the behavior of parents more closely.Another alternative is targeting the behavior of children at different moments throughout their education or including environmental education as a permanent subject in the schools' academic curricula.

We find that our educational program has a stronger effect on children studying in public schools.This finding is highly policy relevant, because children attending public schools in Chile belong to low-income families and experience the worst economic conditions; therefore, this is a population in which promoting environmental values is not always the top priority of relatives and teachers.It is important to add that children from public schools are less likely to have access to recycling infrastructure and to buy products with less plastic content.Hence, for knowledge to translate into actual practices, it is necessary for educational campaigns to be coupled with improved provisions and access to the infrastructure needed to promote sustainable consumption and disposal of plastics.

An obvious question to ask at the end of such an experiment is whether the educational program is scalable.Answering this requires us to respond two ensuing questions: are the expected benefits of the educational program larger than the costs, and if so, can the program be implemented at a large enough number of schools without running into problems that could ultimately result in a reduction of the effect size or an outright implementation failure, i.e., a voltage drop in the language of List (2022)?

With respect to the first question, we believe our experiment should be seen as an efficacy test, namely a small-scale test of whether the educational program delivers significant results under experimental conditions.Note that the focus of our study is not whether plastic pollution is reduced by our intervention, but whether the educational campaign leads to a behavioral change with respect to the use of plastics. This makes the estimation of the benefits from the intervention especially elusive.Moreover, given the complexity of the RCT in this study, and the fact that most materials were prepared ad hoc, it is impossible for us to produce a reasonable approximate of program costs.Some costs are sunk and are therefore high overestimates of the share of fixed costs at scale, and some other costs are most likely underestimated, as is the case for example of oversight costs by supervisors, now done for free by the research team.In addition, we are fully aware that if implemented at scale the educational content of our RCT could crowd out other, potentially very important, educational content, yet such trade-offs do not render themselves easily to a cost benefit analysis and are seldom resolved on efficiency grounds.In this paper we are unable to do a full social cost benefit analysis and must abstain from judging whether the environmental education campaign should take priority over other parts of the school's curricula.

With respect to the second question, i.e., whether the proposed educational campaign could be implemented at scale without running into problems, our major concern would be the teacher's involvement in the program.In our case, the teachers where carefully trained to deliver the educational program and were in continuous interaction with the research team.If implemented at a larger scale, the involvement of the individual teacher is likely to be lower than in the program that was evaluated here.Thus, our estimated impact of the intervention should be regarded as an upper-bound effect of the program.Having said that, it is important to add that based on the preliminary findings of this project, the research team, in collaboration with the local environmental authority, has produced a comprehensive package of teaching materials intended to be used by schools across the country. This takes the form of a teachers' book including all the contents needed to replicate the program in the classroom (i.e., teaching notes and materials; instructions, templates, and solutions to perform the activities embedded in each module both in the classroom and at home with their parents).This book was produced in such way that its adoption could secure an accurate yet homogeneous application of the original program, while minimizing the cognitive burden and the effort needed by the teacher to replicate the contents.This material can be downloaded without any cost for the school, and they are free to implement it in their curriculum.[11]The cost to a school would be the time the individual teachers would have to spend on this material. Although this is not necessarily as comprehensive as the treatment in this paper, it is a low-cost implementation of it.

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.

Data availability

The data that has been used is confidential.

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[11] This material can be retrieved from a link upon request (in Spanish).

Appendix A. Additional tables and figures

Table A1Treatment and control schools

	No.Schools	School type	No.Schools	Socio-economic status	No.Schools	Certification status	No.Schools	Selected schools
Coastal	86	Public	76	Low - Medium/low	68	Basic	18	2
						Excellence	13	2
				Medium	8	Basic	2	2
						Excellence	4	2
		Private	10	Medium	3	Excellence	2	2
				High	4	Excellence	4	4
Non-coastal	119	Public	104	Low	41	Medium	9	2
						Excellence	31	2
				Medium	15	Medium	3	2
						Excellence	11	2
		Private	15	Low- Medium/low	5	Medium	2	2
						Excellence	2	2
				High	4	Excellence	4	5
Total	205		205		148		105	30

Note: Figures based on the records from the sustainable school program.Secretary of the Ministry of the Environment of the Government of Chile, Bio-Bio Region, Chile (2018).

Table A2Pre-treatment KAP scores for public and private schools

Variable	*Public schools*		*Private schools*		*p*-value
	Obs	Mean	Obs	Mean	(Public-Private)
Students					
Knowledge	485	0.562 (0.146)	570	0.601 (0.133)	0.200
Attitudes	473	0.810 (0.192)	556	0.794 (0.203)	0.522
Practices - Lunch Box	475	0.481 (0.360)	548	0.471 (0.331)	0.749
Practices - Consumption	461	0.535 (0.216)	557	0.597 (0.211)	0.047*
Practices - Recycling	474	0.447 (0.281)	562	0.499 (0.280)	0.095
Parents					
Knowledge	359	0.678 (0.105)	453	0.704 (0.096)	0.425
Attitudes	336	0.862 (0.167)	442	0.835 (0.183)	0.301
Practices - Lunch Box	343	0.397 (0.371)	439	0.473 (0.343)	0.034*
Practices - Consumption	340	0.622 (0.222)	432	0.642 (0.207)	0.567
Practices - Recycling	343	0.316 (0.286)	444	0.372 (0.297)	0.102

Note: Own calculations based on *ex-ante* data.Standard deviations in parentheses.Statistical inference is based on a two-sample test for proportions.Reported *p*-values are not corrected for multiple hypothesis testing.
* Statistically significant differences at the 10% level after Bonferroni correction of *p*-values.

Table A3Pre-treatment KAP scores by treatment status for public and private schools (Students)

Variable	*Treatment*		*Control*		*p*-value
	Obs	Mean	Obs	Mean	(T – C)
Public schools					
Knowledge	223	0.531 (0.156)	262	0.589 (0.132)	0.199
Attitudes	214	0.796 (0.192)	259	0.822 (0.190)	0.473
Practices - Lunch Box	222	0.477 (0.336)	253	0.486 (0.380)	0.845
Practices - Consumption	209	0.512 (0.220)	252	0.554 (0.211)	0.368
Practices - Recycling	216	0.437 (0.263)	258	0.456	0.679
Private schools					
Knowledge	331	0.607 (0.133)	239	0.594 (0.132)	0.754
Attitudes	328	0.786 (0.203)	228	0.805 (0.204)	0.586
Practices - Lunch Box	327		221		0.175

(*continued on next page*)

(*continued*)

Variable	*Treatment*		*Control*		*p*-value
	Obs	Mean	Obs	Mean	(T – C)
		0.447		0.506	
		(0.317)		(0.348)	
Practices - Consumption	326	0.615	231	0.570	0.286
		(0.206)		(0.216)	
Practices - Recycling	326	0.503	236	0.493	0.815
		(0.284)		(0.276)	

Note: Own calculations based on *ex-ante* data.Standard deviations in parentheses.Statistical inference is based on a two-sample test for proportions.Reported *p*-values are not corrected for multiple hypothesis testing.

Table A4Pre-treatment KAP scores by treatment status for public and private schools (Parents)

Variable	*Treatment*		*Control*		*p*-value
	Obs	Mean	Obs	Mean	(T – C)
Public schools					
Knowledge	161	0.672	198	0.683	0.824
		(0.112)		(0.100)	
Attitudes	154	0.87	182	0.856	0.711
		(0.174)		(0.161)	
Practices - Lunch Box	153	0.422	190	0.377	0.397
		(0.384)		(0.360)	
Practices - Consumption	149	0.626	191	0.618	0.880
		(0.235)		(0.212)	
Practices - Recycling	155	0.316	188	0.316	1.000
		(0.291)		(0.284)	
Private schools					
Knowledge	295	0.719	158	0.674	0.318
		(0.085)		(0.108)	
Attitudes	291	0.827	151	0.848	0.574
		(0.184)		(0.181)	
Practices - Lunch Box	287	0.458	152	0.502	0.380
		(0.324)		(0.376)	
Practices - Consumption	287	0.659	145	0.608	0.297
		(0.190)		(0.234)	
Practices - Recycling	290	0.384	154	0.350	0.481
		(0.301)		(0.288)	

Note: Own calculations based on *ex-ante* data.Standard deviations in parentheses.Statistical inference is based on a two-sample test for proportions.Reported *p*-values are not corrected for multiple hypothesis testing.

Table A5Descriptive statistics of households and parents' characteristics by school type

Variable	*Public schools*		*Private*		*p*-value	*p*-value	*p*-value
	Obs.	Mean	Obs.	Mean	$(p_1 = p_2)$	$(\sigma_1^2 = \sigma_2^2)$	$(\sigma_1^2 \neq \sigma_2^2)$
Parents/guardian's characteristics							
Age of guardian [*years*]	343	37.8	431	39.1	–	0.014**	0.015**
		(7.548)		(6.922)			
Mother's formal education [*years*]	361	11.6	455	13.6	–	0.000***	0.000***
		(2.900)		(3.229)			
Father's formal education [*years*]	335	11.5	432	13.6	–	0.000***	0.000***
		(3.070)		(3.754)			
Children living with both parents [%]	375	0.68	465	0.69	0.698	0.699	0.699
		(0.467)		(0.462)			
Households' characteristics							
Households' income [*CLP$/month*]	363	428,925	441	869,955	–	0.000***	0.000***
		(284,941)		(710,545)			
Household size [No.]	375	4.6	464	4.3	–	0.001***	0.001***
		(1.415)		(1.253)			

Note: Own calculations based on *ex-ante* data.Standard deviations in parentheses.Test of differences in baseline characteristics was based on two tests: a test of difference in proportions, which was applied to variables represented in shares/proportions, and a *t*-test (for both equal and different sample variances) that was applied to continuous variables.

***Statistically significant differences at the 1% level after Bonferroni correction of *p*-values.**Statistically significant differences at the 5% level after Bonferroni correction of *p*-values.*Statistically significant differences at the 10% level after Bonferroni correction of *p*-values.

Table A6
Pre-treatment KAP scores by treatment status for public and private schools

Variable	*Treatment*		*Control*		*p*-value	*p*-value	*p*-value
	Obs	Mean	Obs	Mean	$(p_1 = p_2)$	$(\sigma_1^2 = \sigma_2^2)$	$(\sigma_1^2 \neq \sigma_2^2)$
Public schools							
Age of guardian [*years*]	162	36.9 (7.017)	181	38.6 (7.925)	–	0.0346**	0.0335**
Mother's formal education [*years*]	167	11.7 (2.524)	194	11.6 (3.195)	–	0.8782	0.8761
Father's formal education [*years*]	159	11.4 (2.788)	176	11.5 (3.312)	–	0.9177	0.917
Children living with both parents [%]	174	0.695 (0.462)	201	0.667 (0.473)	0.5519	0.5531	0.5525
Households' income [*CLP$/month*]	169	401,775 (236,850)	194	452,577 (319,761)	–	0.0902*	0.0839*
Household size [No.]	174	4.7 (1.365)	201	4.6 (1.455)	–	0.2528	0.2506
Private schools							
Age of guardian [*years*]	285	39.7 (6.930)	146	37.8 (6.761)	–	0.008**	0.008**
Mother's formal education [*years*]	299	14.3 (3.101)	156	12.2 (3.022)	–	0.000***	0.000***
Father's formal education [*years*]	284	14.6 (3.539)	148	11.6 (3.331)	–	0.000***	0.000***
Children living with both parents [%]	305	0.702 (0.458)	160	0.675 (0.470)	0.5543	0.555	0.559
Households' income [*CLP$/month*]	285	1,071,754 (776,334)	156	501,282 (342,380)	–	0.000***	0.000***
Household size [No.]	304	4.2 (1.186)	160	4.5 (1.360)	–	0.031**	0.039**

Note: Own calculations based on *ex-ante* data.Standard deviations in parentheses.Test of differences in baseline characteristics was based on two tests: a test of difference in proportions, which was applied to variables represented in shares/proportions, and a *t*-test (for both equal and different sample variances) that was applied to continuous variables.*** Statistically significant differences at the 1% level after Bonferroni correction of *p*-values.**Statistically significant differences at the 5% level after Bonferroni correction of *p*-values.* Statistically significant differences at the 10% level after Bonferroni correction of *p*-values.

Table A7
Observations on- and off-support

Treatment assignment	*Common support*		Total
	Off support	On support	
Untreated	0	374	374
Treated	3	457	460
Total	3	831	834

Note: Own elaboration based on the matching estimates.

Table A8
Testing the balance of covariates after matching

Variable	Unmatched	*Mean*			% Reduction	*t-test*		V(T)/
	Matched	Treated	Control	% Bias	|bias|	*t*	*p*>|test|	V(C)
School type	U	1.846	1.559	41.0		5.82	0.000	1.53*
	M	1.838	1.845	−1.0	97.6	−0.14	0.892	0.98
Mother's education	U	13.27	12.305	29.1		4.17	0.000	1.08
	M	13.26	13.294	−0.9	96.7	−0.14	0.887	1.05
Father's education	U	13.14	11.992	31.3		4.48	0.000	1.16
	M	13.11	12.942	4.5	85.8	0.66	0.511	1.02
Income	U	840,000	580,000	42.5		6.00	0.000	1.96*
	M	840,000	840,000	−0.1	99.7	−0.02	0.988	0.98

Note: * if variance ratio outside [0.83; 1.20] for U and [0.83; 1.20] for M.

Table A9
Testing the performance of the matching procedure

Sample	Ps R2	LR chi2	p > chi2	Mean Bias	Med.Bias	B	R	%Var
Unmatched	0.037	42.59	0.000	36	36.2	46.1*	2.00*	50
Matched	0.001	1.44	0.837	1.6	1	7.9	1.04	0

Note: * if B>25%, R outside [0.5; 2].

Table A10
Homogenous treatment effects on school children (Unmatched sample)

Variables	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.067***	0.053**	0.110***	0.077**	0.070**
	(0.014)	(0.018)	(0.027)	(0.023)	(0.022)
Post-treatment	0.034**	−0.001	−0.011	−0.007	−0.025
	(0.010)	(0.013)	(0.021)	(0.014)	(0.014)
Constant	0.583***	0.803***	0.470***	0.570***	0.475***
	(0.003)	(0.005)	(0.007)	(0.006)	(0.006)
No.Observations	2110	1948	1936	1950	2022
No.Individuals	1055	974	968	975	1011
Adjusted R^2	0.181	0.023	0.032	0.037	0.012
F-test	67.52	7.92	17.99	7.13	5.05

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (school level).*P*-values are Bonferroni corrected for multiple hypothesis testing.

Table A11
Homogenous treatment effects on parents (Unmatched sample)

Variables	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.006	0.013	0.051	−0.028	0.002
	(0.009)	(0.014)	(0.027)	(0.016)	(0.019)
Post-treatment	−0.007	0.004	−0.009	0.040***	0.040*
	(0.007)	(0.011)	(0.021)	(0.012)	(0.015)
Constant	0.692***	0.846***	0.436***	0.633***	0.343***
	(0.002)	(0.003)	(0.007)	(0.004)	(0.005)
No.Observations	1624	1532	1546	1514	1572
No.Individuals	812	766	773	757	786
Adjusted R^2	0.000	0.003	0.007	0.015	0.022
F-test	0.48	1.78	3.19	6.06	9.46

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (household level).*P*-values are Bonferroni corrected for multiple hypothesis testing.

Table A12
Heterogeneous treatment effects on school children (Unmatched sample)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treat × Post-treatment × Public	0.076***	0.075*	0.124***	0.140***	0.122***
	(0.020)	(0.027)	(0.035)	(0.024)	(0.021)
Treat × Post-treatment × Private	0.062***	0.038	0.101***	0.036	0.035
	(0.01)	(0.019)	(0.029)	(0.020)	(0.020)
Post-treatment	0.034**	−0.001	−0.011	−0.007	−0.025
	(0.010)	(0.013)	(0.021)	(0.014)	(0.014)
Constant	0.583***	0.804***	0.470***	0.570***	0.475***
	(0.003)	(0.005)	(0.007)	(0.005)	(0.004)
No.Observations	2110	1948	1936	1950	2022
No.Individuals	1055	974	968	975	1011
Adjusted R^2	0.181	0.025	0.032	0.056	0.021
F-test	53.301	5.76	12.07	17.24	14.67

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (school level).*P*-values include are Bonferroni corrected for multiple hypothesis testing.

Table A13
Heterogeneous treatment effects on parents (Unmatched sample)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treat × Post-treatment × Public	0.016	0.007	0.063	−0.053*	−0.001
	(0.012)	(0.017)	(0.036)	(0.022)	(0.026)
Treat × Post-treatment × Private	0.001	0.016	0.045	−0.015	0.003
	(0.009)	(0.016)	(0.030)	(0.017)	(0.021)
Post-treatment	−0.007	0.004	−0.009	0.040***	0.040**
	(0.007)	(0.011)	(0.021)	(0.012)	(0.015)
Constant					

(*continued on next page*)

Table A13 (*continued*)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
	0.692***	0.846***	0.436***	0.633***	0.343***
	(0.002)	(0.004)	(0.007)	(0.004)	(0.005)
No.Observations	1624	1532	1546	1514	1572
No.Individuals	812	766	773	757	786
Adjusted R^2	0.002	0.003	0.006	0.018	0.022
F-test	0.94	1.19	2.18	5.20	6.33

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (household level).*P*-values are Bonferroni corrected for multiple hypothesis testing.

Table A14
Homogenous treatment effects on children (Social unrest – closing of the program)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.090***	0.075	0.127***	0.026	0.091*
	(0.011)	(0.038)	(0.036)	(0.026)	(0.036)
Treatment × Post-treat.× Closing-unrest	−0.025*	−0.025	−0.018	0.055	−0.023
	(0.010)	(0.039)	(0.034)	(0.030)	(0.038)
Post-treatment	0.034***	−0.001	−0.011	−0.007	−0.025
	(0.010)	(0.013)	(0.021)	(0.014)	(0.014)
Constant	0.583***	0.804***	0.470***	0.570***	0.475***
	(0.003)	(0.005)	(0.007)	(0.006)	(0.006)
No.Obs.	2110	1948	1936	1950	2022
No.ID	1055	974	968	975	1011
Adjusted R^2	0.181	0.023	0.032	0.038	0.012
F-test	50.46	5.82	15.47	4.87	4.23

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (School level).*P*-values are Bonferroni corrected for multiple hypothesis testing.The variable Closing-unrest denotes the schools where the closing of the program took place after the social unrest experienced in Chile from October 18th, 2019.

Table A15
Homogenous treatment effects on parents (Social unrest – closing of the program)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	−0.011	−0.014	−0.009	−0.039	−0.028
	(0.017)	(0.035)	(0.064)	(0.044)	(0.056)
Treatment × Post-treat.× Closing-unrest	0.019	0.030	0.067	0.012	0.032
	(0.017)	(0.034)	(0.063)	(0.043)	(0.056)
Post-treatment	−0.007	0.004	−0.009	0.040**	0.040**
	(0.007)	(0.011)	(0.021)	(0.012)	(0.015)
Constant	0.692***	0.846***	0.436***	0.633***	0.343***
	(0.002)	(0.004)	(0.007)	(0.004)	(0.005)
No.Observations	1624	1532	1546	1514	1572
No.Individuals	812	766	773	757	786
Adjusted R^2	0.001	0.004	0.008	0.014	0.022
F-test	0.76	1.54	2.56	4.10	6.74

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (Household level).*P*-values are Bonferroni corrected for multiple hypothesis testing. The variable closing-unrest denotes the schools where the closing of the program took place after the social unrest experienced in Chile from October 18th, 2019.

Table A16
Homogenous treatment effects on children (Social unrest – schools)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.065***	0.050*	0.109***	0.082**	0.068**
	(0.014)	(0.019)	(0.028)	(0.025)	(0.023)
Post-treatment	0.034***	−0.001	−0.011	−0.007	−0.025
	(0.011)	(0.013)	(0.021)	(0.014)	(0.014)
Constant	0.583***	0.802***	0.473***	0.566***	0.475***
	(0.004)	(0.005)	(0.007)	(0.006)	(0.006)
No.Observations	2010	1850	1844	1858	1926
No.Individuals	1005	925	922	929	963
Adjusted R^2	0.17	0.02	0.03	0.04	0.01
F-test	55.77	6.60	14.93	6.90	4.31

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (School level).*P*-values are Bonferroni corrected for multiple hypothesis testing. Estimates are based on the subsample of schools that closed the program after the social unrest experienced in Chile in October 18th, 2019.

Table A17
Homogenous treatment effects on parents (Social unrest – schools)

Variable	Knowledge	Attitudes	Practices - Lunch Box	Practices - Consumption	Practices - Recycling
	(1)	(2)	(3)	(4)	(5)
Treatment × Post-treatment	0.008	0.016	0.057	−0.027	0.004
	(0.009)	(0.014)	(0.027)	(0.016)	(0.019)
Post-treatment	−0.007	0.004	−0.009	0.040**	0.040**
	(0.007)	(0.011)	(0.021)	(0.012)	(0.015)
Constant	0.691***	0.845***	0.432***	0.632***	0.344***
	(0.002)	(0.004)	(0.007)	(0.004)	(0.0054)
No.Observations	1532	1446	1468	1436	1494
No.Individuals	766	723	734	718	747
Adjusted R^2	0.0003	0.005	0.008	0.016	0.025
F-test	0.51	2.26	3.80	6.15	10.09

Note: *p < 0.1; **p < 0.05; ***p < 0.01.Clustered standard errors in parentheses (Household level).*P*-values are Bonferroni corrected for multiple hypothesis testing. Estimates are based on the subsample of schools that closed the program after the social unrest experienced in Chile in October 18th, 2019.

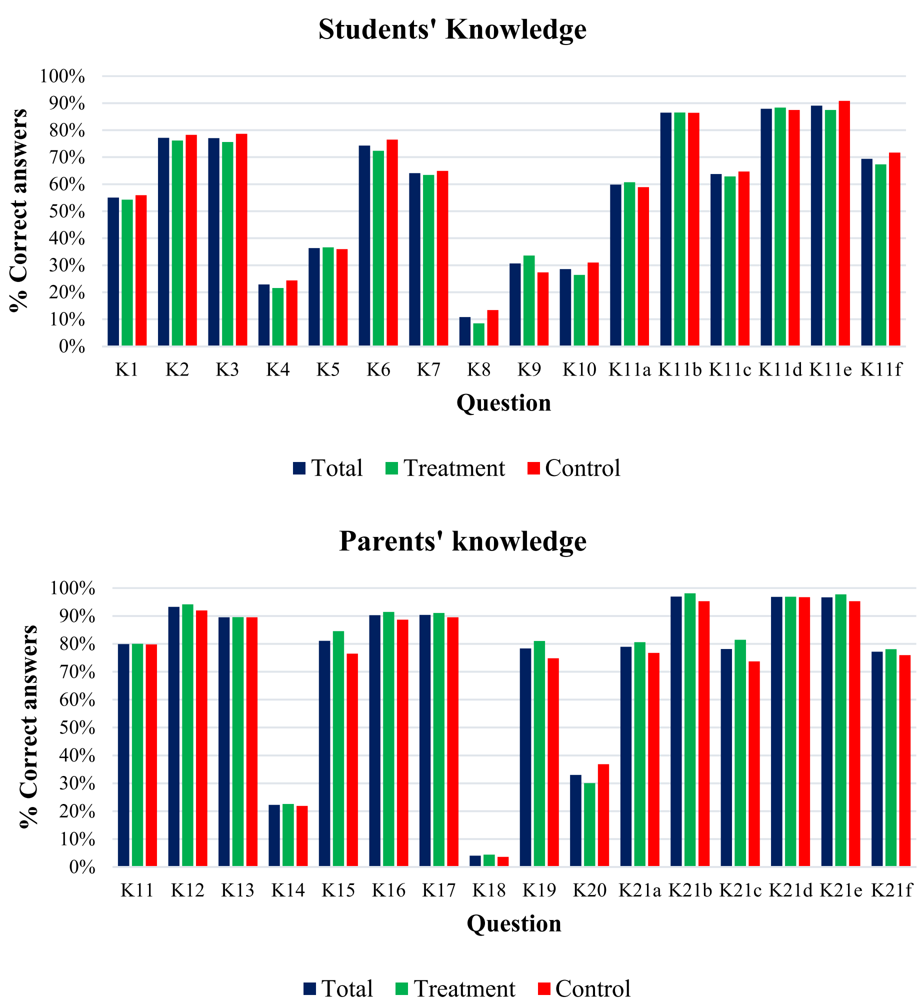
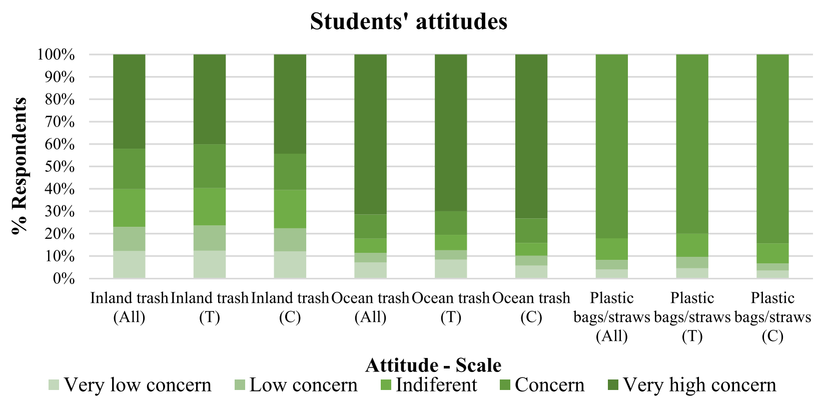
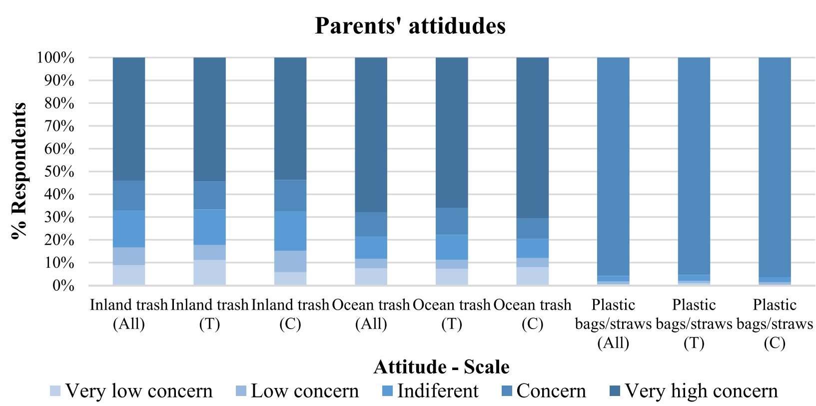


Fig.A1. Pre-treatment knowledge





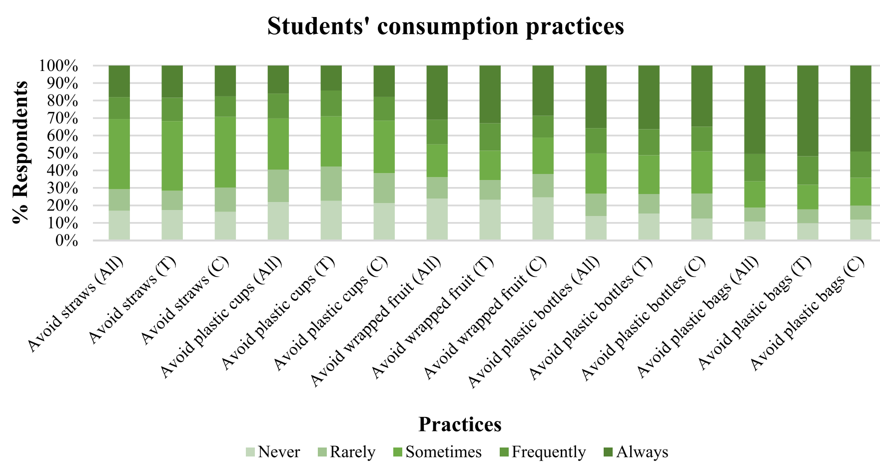
Q1. In a 1-5 scale, please indicate to which extent the following environmental problems affect your commune. [1= do not affect; 5= affect a lot]

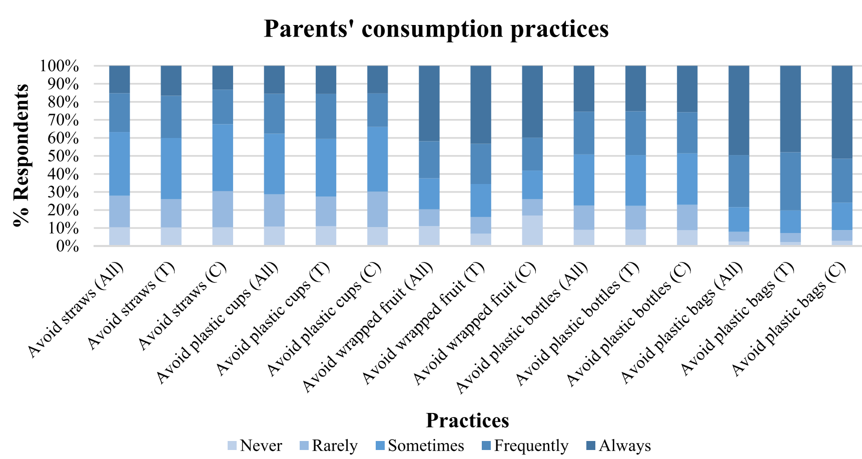
▪ Climate change ▪ Trash (inland) ▪ Trash (ocean) ▪ Air pollution	▪ Water pollution ▪ Acoustic pollution ▪ Lack of trees and green areas ▪ Droughts	▪ Abandoned dogs ▪ I don't know

Q2. How important it is for you not to use plastic bags and straws?

Very important		Important		Not important	

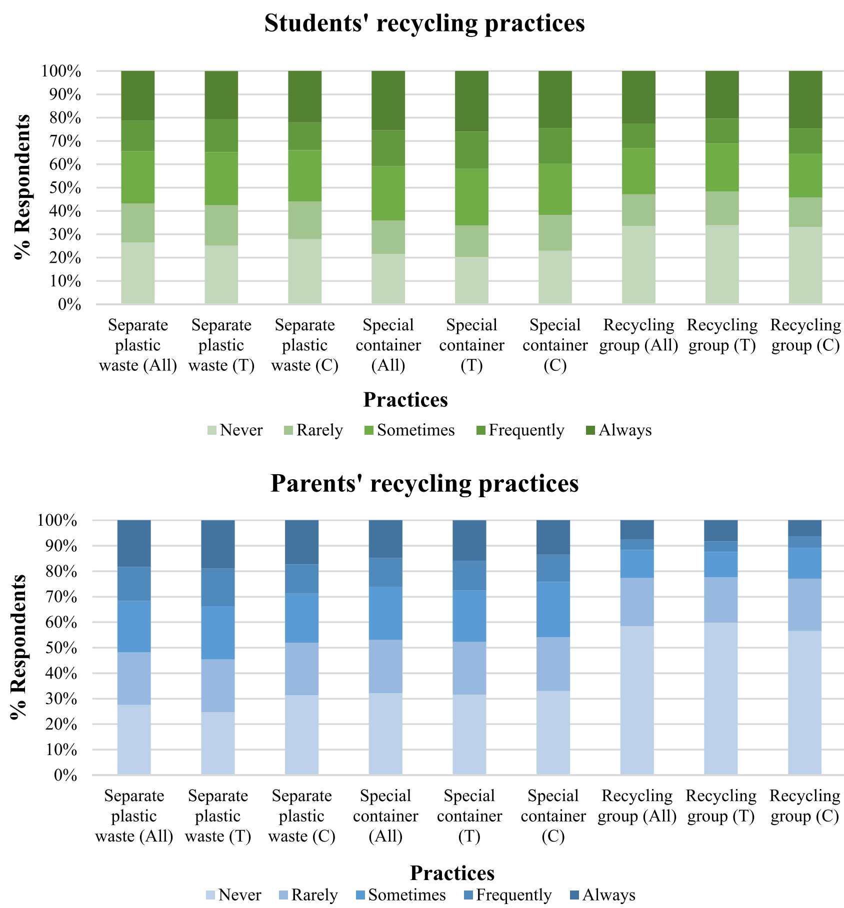
Fig.A2. Pre-treatment attitudes





Q1. Item	Never	Rarely	Sometimes	Frequently	Always
Refuse plastic straws with drinks					
Avoid buying drinks to take away in plastic cups					
Avoid buying fruit and vegetables wrapped in plastic					
Avoid buying plastic bottles and prefer using reusable bottles.					
Avoid using plastic bags and take reusable bags to buy in supermarkets and shops					

Fig.A3. Pre-treatment consumption practices



Q1. Item	Never	Rarely	Sometimes	Frequently	Always
Separate plastic garbage (plastic containers, plastic bottles, etc.)					
Take plastic material to special container for recycling					
Participate in groups to help recycling and environment					

Fig.A4. Pre-treatment recycling practices

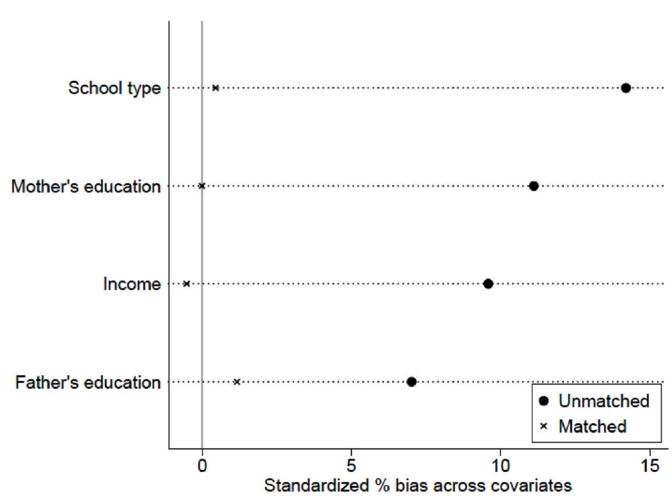


Fig.A5. Performance of the matching procedure

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