ECONOMETRIC ANALYSIS: THE EFFECTIVENESS OF ENVIRONMENTAL EDUCATION IN ELEMENTARY SCHOOLS

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ECONOMETRIC ANALYSIS: THE EFFECTIVENESS OF ENVIRONMENTAL EDUCATION IN ELEMENTARY SCHOOLS

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Abstract

This research study focuses on analyzing the effectiveness of environment-friendly practices and programs in schools on creating environment-friendly habits and raising environmental awareness of elementary school students. We select two different elementary schools in Colorado Springs and survey students aged between 7 and 11 years old. We use the Seemingly Unrelated Regressions (SUR) model to analyze our data. The results show that the school with stronger environmental program and focus does have a relevant positive impact on the environment conscious answers to questions in the student survey. Interestingly, we also find that students' age and gender seem to have no significant impact on students' answers.

KEYWORDS: (Environmental Economics, Education, Economerics)

JEL CODES: (Q5, I2, C01)

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MArketa Harastova

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SECTION 1 - Introduction

Climate change and natural disasters have become a progressively more urging matter for the contemporary society. The scientific research shows that humans have both direct and indirect impact on climate change by introducing new species to habitats, altering levels CO_2, and consequently, changing global temperatures (Hulme, 2016; Alpert et al., 2006). Furthermore, researchers find connections between human induced climate change and weather extremes (Van Aalst, 2006). In the light of recent and more frequent natural disasters, there is an urge to protect the environment. The sub-headline of an *Environmental Protection* news article says: “In the next five years, we'll see sustainability in commercial projects moving from a luxury to a requirement.” (2017). In order to match the increasing demand for environment-friendly products and practices, we need to educate the upcoming generation of citizen and leaders. “The goal of environmental education is to contribute to the development of an environmentally literate and responsible citizen, one who can make decisions that will help restrain the environmental problems that arise in the twenty-first century**.”** (Stanišić & Maksić, 2014). We have recently seen an increase in the integration environment-friendly programs and practices to schools if which the Green Schools in the United States serve as a great example (Gordon, 2010).

For instance, EU-countries have a set of guidelines for environmental education programs as part of schools’ curricula (Stanišić & Maksić, 2014). Therefore, we found a lot of research that analyzes the effectiveness of these programs. In the United States, each state has different standards for each grade level and environmental education is usually incorporated into science classes (Colorado Department of Education). However, there is a lack of research available elaborating on the effectiveness of the environmental education in the classrooms in the United States. Within that framework some American schools put a lot of emphasis on environmental education, while others focus on different stakes such as increasing test scores and the government funding. Our research study attempts to fill this research gap. For reasons of data accessibility and variance in schools' approaches to environmental education, we have chosen to perform our research and surveys in Colorado Springs elementary schools.

This research aims to analyze the effectiveness of environmental education programs in two elementary schools in Colorado Springs. The elementary schools are carefully selected based on their different approaches to setting educational goals. The first school, called Mountain Song Community School, follows the Waldorf educational philosophy where caring for the environment plays a very significant role. The second school, Soaring Eagles Elementary, is in district 2 and is renowned for its high achievement in grade level state testing. We have selected elementary schools because the literature shows that the children are more prone to acquiring new habits and attitudes during that period of schooling (Loewenstein et al., 2015). Our hypothesis states the following: "Environmental education, as part of elementary school program, has a positive and relevant effect on both students' environmental awareness and their environment-friendly habits."

To test our hypothesis, we will first meet with the school principals for a short interview about their school's environmental practices. Simultaneously, we will distribute our student survey about environment-friendly habits and awareness to the classroom teachers who will complete the survey with their students. The literature review section draws on similar studies done in environmental education and habit formation that serve as an inspiration for our survey. Once we acquire the data, we will code them appropriately and set up our model. The theory section will build on the Becker-Murphy model of rational addiction (Becker & Murphy, 1988) and the data presentation section will look at both data summary statistics and potential econometric issues of our model. The results section will follow with our regression outputs. We will then interpret relevant variables and look at the significance of z-values. Finally, the conclusions and implications section will reflect on the study and explore potential research improvements and possibilities in this area.

SECTION 2 - Literature Review

Studying environmental awareness of society is not new to the field. Singh & Aziz conducted their research to assess environmental awareness of teachers in Allahabad district in India. While there was no significant difference between male and female teachers and between rural and urban teachers, they found a significant difference in the environmental awareness in favor of private school teacher in Allahabad district. A similar study was done in two provinces in South Africa. The goal of that research was to assess secondary school student's awareness, knowledge and attitudes to environmental pollution issues in the mining regions (Olufemi et al., 2014). They used age-appropriate surveys and looked at differences between students from a mining and a non-mining province. The results showed that the secondary school students from Mpumalanga (mining province) had significantly higher mean scores on the awareness, knowledge and attitude (AKA) survey than their counterparts. While we found a lot of literature on research in environmental awareness from different countries, there is no available research done with elementary school students in the United States of America.

"Only in the past 10-15 years have social researchers acknowledged the importance of conducting survey research with children directly" (Bell, 2007). When drafting our survey, the inspiration from Bell's research on designing and testing questionnaires for children proved to be very helpful. In her paper, she stresses the importance of shortening and precising the questions when surveying younger children (Bell, 2007). Furthermore, Bell put emphasis on comprehensive syntax, a limited number of answers and engaging and appropriate visual images. While Bell provided general guidelines, Yilmaz et al. (2004) applied them to elementary and middle school Turkish students in attempts to evaluate their environmental awareness. They looked at several factors such as gender, grade level, science courses completed, socioeconomic status and school location. One particularly interesting finding for our study was that students who had successfully completed science courses prior to the study exhibited more positive behaviors towards the environment (Yilmaz et al., 2004).

Due to the lack of research done in the U.S. with regards to environmental education effectiveness, we looked at the rising presence of Green Schools. Kats (2006) goes in depth on the cost benefits over the lifetime of a new energy efficient building. He also outlines the statistics about waste and pollution reduction thanks to renewable energy sources (Kats, 2006). However, certain factors such as higher costs of building, lack of awareness of benefits discourage from investing into Green Schools. Gordon (2010) adds to the benefit analysis by highlighting the importance of healthy learning environment for students, faculty and staff of the schools. From both studies, it is apparent that efforts to make schools more environment-friendly exist and are growing. However, neither of these studies goes into detail about their curricula nor its effectiveness.

Furthermore, the habit formation and rational addiction models provided a good foundation for the econometric modeling part of our data. The rational addiction model

(Becker & Murphy, 1988) is dynamic and accounts for tolerance, withdrawal and reinforcement. Although this model has not yet been applied to this particular phenomenon, the development of moral principles toward environmental awareness and habits seems to mirror the three aspects of addiction very well. Another research study uses the rational addiction to model demand for cinema (Cameron, 1999). However, his data is not very well-explained using this model.

Finally, we can see that our study fills in certain gaps in the literature. Firstly, there is little research done working with elementary school students who are the upcoming generation of world citizens and leaders. Secondly, the research evaluating environmental awareness and practices that is available focuses on countries other than the U.S. Thirdly, collecting data both directly from the school administration and the students provides us with more in-depth understanding of the school's involvement. Lastly, we attempt to adapt an existing economic model to derive the demand for/presence of environment-friendly practices of the individual students.

SECTION 3 - Theory and modeling

This section will focus on building a rational addiction model (RA model) to account for all of our variables. Firstly, we will elaborate on how our study connects to the RA model. Then, we will set up our Lagrangean with all the variables and constraints and follow the Becker & Murphy's (1988) method of demand derivation. This demand function will represent all the variables; however we will eventually adjust our model in accordance with the collected data.

The RA model by Becker & Murphy (1988) is a dynamic model. In this model, "rational means a consistent plan to maximize utility over time." Although their research paper focuses on addictive behavior towards substances such as alcohol and cigarettes, the authors highlight that individuals also get addicted to intangible goods such as standard of life, work or other activities (Becker, ibid.). One of the assumptions made in our study is that environment-friendly practices are habitual. When an individual gets used to thinking in an environment-friendly way, there is a moral commitment to pursue the environment caring practices. Due to the negative connotations associated with the word “addiction”, we refer to environment-friendly practices as a “habitual activity”.

In the RA model, the good or during the activity impacts the individual in several ways. A “hooked” consumer experiences tolerance, reinforcement when using the addictive substance, and then withdrawal when consumption is ceased. Tolerance can be defined as achieving a lower level of response from a given amount of the addictive substance. In our model, tolerance is represented by the higher feeling of satisfaction by engaging in environment-friendly practices that decreases as the activities become part of daily life routine. Reinforcement refers to the increasing benefit from each additional unit of the substance as the individual acquires more experience with the drug. In our model, reinforcement is reflected by strengthening of the moral principles surrounding environment-friendly habits. Finally, withdrawal is defined as a reduction in the individual’s utility due to a reduction or termination of consumption. In our model, withdrawal is the guilt and self-doubt that the individual feels when disengaging in environment-friendly activities.

Having elaborated on the RA model and its connections to phenomenon we are studying, we now proceed to the derivation of our demand using the Becker & Murphy’s method. For practical reasons, we use a quadratic utility function. This way, we work with linear first-order conditions throughout the derivation. Below is the setup of our utility maximization problem:

(1) $\mathrm{Max}\sum_{t=1}^{T}\beta^{t-1}U(C_t, A_t, Y_t, AGE_t, G_t, S_t, e_t)$ where Y_t is the numeraire, AGE_t is age, G_t is gender, S_t is the school of attendance and e_t are unobservable life events.

$$\text{s.t. } \sum_{t=1}^{T}\beta^{t-1}(P_tC_t + Y_t) = W^0 \quad \text{s.t. } A_t = C_{t-1} \quad \text{s.t. } C_0 = C^0, \quad \text{where } \beta = \frac{1}{1+r}$$

is rate of time preference, P_t is price of environment-friendly habits and A_t is addictive(habitual) stock.

Next, we substitute for the addictive stock (A_t) into our lifetime utility function (2) for environment-friendly practices:

$$\sum_{t=1}^{T}\beta^{t-1}U(C_t, C_{t-1}, Y_t, AGE_t, G_t, S_t, e_t),$$

We then set up a Lagrangean for our lifetime utility function (3) with the constraints of the problem:

$$(3)\ L = \sum_{t=1}^{T}\beta^{t-1}U(C_t, C_{t-1}, Y_t, AGE_t, G_t, S_t, e_t) + \lambda\{W^0 - \sum_{t=1}^{T}\beta^{t-1}(P_tC_t + Y_t)\},$$

Now, we take the partial derivatives of the Lagrangian with respect to Y_t and C_t in order to get the first order necessary conditions (F.O.N.C), (4) and (5):

$$(4)\ \frac{\partial L}{\partial Y_t} = \frac{\partial U(\cdot)}{\partial Y_t} = \lambda,$$

In equation (4), the marginal utility of the Y_t is equal to the marginal utility of income(λ)

$$(5)\ \frac{\partial L}{\partial C_t} = \frac{\partial U(\cdot)}{\partial C_t} + \beta\frac{\partial U_2(\cdot)}{\partial C_t} = \lambda P_t\ ,$$

In equation (5), the marginal utility of C_t in the current (t) and future (t+1) consumption period is equal to the marginal utility of income (λ), where income means financial funds but also time and possibilities, multiplied by price (P_t). Similarly, price of the environment-friendly practices refers not only to monetary costs but to opportunity costs as well.

After solving the system of equation by substituting for Y_t and Y_{t+1}, we get the following demand function (6) for current (t) consumption of environment-friendly practices (C_t):

$$(6) C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 AGE_t + \alpha_3 G_t + \alpha_4 S_t + \alpha_5 e_t + \alpha_6 c_{t+1} + \alpha_7 AGE_{t+1} + \alpha_8 G_{t+1} + \alpha_9 S_{t+1} + \alpha_{10} e_{t+1} + \alpha_{11} P_t$$

$$\Omega = \left[U_{11} - \frac{U_{13}^2}{U_{33}} + \beta\left(U_{22} - \frac{U_{23}^2}{U_{33}}\right)\right],$$

$$\alpha_0 = -\frac{\left[U_1 - \frac{U_{13}U_3}{U_{33}} + \beta\left(U_2 - \frac{U_{23}U_3}{U_{33}}\right)\right]}{\Omega}, \alpha_1 = -\frac{\left[U_{12} - \frac{U_{13}U_{23}}{U_{33}}\right]}{\Omega}, \alpha_2 = -\frac{\left[U_{14} - \frac{U_{13}U_{34}}{U_{33}}\right]}{\Omega},$$

$$\alpha_3 = -\frac{\left[U_{15} - \frac{U_{13}U_{35}}{U_{33}}\right]}{\Omega}, \alpha_4 = -\frac{\left[U_{16} - \frac{U_{13}U_{36}}{U_{33}}\right]}{\Omega}, \alpha_5 = -\frac{\left[U_{17} - \frac{U_{13}U_{37}}{U_{33}}\right]}{\Omega},$$

$$\alpha_6 = -\frac{\beta\left[U_{12} - \frac{U_{23}U_{13}}{U_{33}}\right]}{\Omega}, \alpha_7 = -\frac{\beta\left[U_{24} - \frac{U_{23}U_{34}}{U_{33}}\right]}{\Omega}, \alpha_8 = -\frac{\beta\left[U_{25} - \frac{U_{23}U_{35}}{U_{33}}\right]}{\Omega},$$

$$\alpha_9 = -\frac{\beta\left[U_{26} - \frac{U_{23}U_{36}}{U_{33}}\right]}{\Omega}, \alpha_{10} = -\frac{\beta\left[U_{27} - \frac{U_{23}U_{37}}{U_{33}}\right]}{\Omega}, \alpha_{11} = \frac{[\lambda]}{\Omega}$$

Where the U_{ij} are coefficients from the initial utility function used in the demand function derivation process.

As we observe from the demand function, the rational addiction model is dynamic and therefore, the individual's demand for environment-friendly practices (C_t) is dependent on the future consumption period (t+1) and past consumption of C_t. Consequently, the number of factors that affect an individual's decision-making double. When it comes to past, current and future "consumption" of environment-friendly practices, we can see the interconnections as the habits form. For instance, if the individual was recycling, composting and caring for the environment in the past period (t-1), he/she would more likely continue these activities in the present than someone who has just recently found out about recycling.

In this rational model, we would also consider the agent's age (AGE_t), gender (G_t) and the school (S_t) in the current and the future period. While it would be interesting for future research to use this dynamic approach for this study and collect student data at three different periods in time (t-1, t, t+1), we face a time restriction and limited resources. Due to the lack of time to collect real data, We are unfortunately unable to put our theory into action in this research and we have to resort to the myopic model to analyze the variation in students' answers about environmental awareness and environment-friendly habits. Finally, we modify this myopic model even further to account for both endogenous and exogenous variables.

In the myopic model, we still include all the above mentioned exogenous variables: AGE, G and S. Additionally, we collected information about their grade level (GRA) and pre-school attendance (PRE), and we incorporate both into the myopic model. Aside from these five exogenous variables, some of the students' answers may impact one another. In other words, individual questions may also be influenced by the answers to some of the thirteen remaining answers (ANS 1-14). Overall, this model uses eighteen independent variables that aim to explain the variation in the student's answers to the environmental awareness and habits questionnaire (C):

$$(7)\mathrm{C} = \alpha_0 + (\alpha_1 ANS_{1-14} + .. + \alpha_{13} ANS_{1-14}) + \alpha_{14}\mathrm{AGE} + \alpha_{15}\mathrm{G} + \alpha_{16}\mathrm{S} + \alpha_{17}\mathrm{GRA} + \alpha_{18}\mathrm{PRE} + \alpha_{19} e$$

Where AGE is age, G is gender (0 = Male, 1 = Female), S is school of attendance (0 = Soaring Eagles Elementary and 1 = Mountain Song Community School), GRA is grade level, PRE is attendance in a preschool (0 = did not attend, 1 = attended) and ANS_{1-14} represent the thirteen remaining answers on the questionnaire.

In the following section, we will summarize our data and present different summary statistics organized in tables. We will also run certain econometric tests and treat our data for the major econometric issues before we set up our regressions.

SECTION 4 - Data Presentation

Our data collection encountered a few obstacles due to the age of our respondents (7-11 years old) but once approved by the Institutional Review Board at Colorado College, we could begin collecting our data. Due to the incompleteness of responses, we had to eliminate one survey. With the help of administrators and teachers at Soaring Eagles Elementary and Mountain Song Community School, we collected parental consents, assent forms and completed questionnaires from 65 students in total. This yielded 910 answers that may be environment-friendly or not. *Table 1* focuses on the overall data from each school in terms of student distribution across grade levels, preschool attendance and gender.

Table 1

	Respondents		Preschool Attendance	Grade level	
Soaring Eagles Elementary	Total	38	31	2nd Graders	15
	Female	26	21	4th Graders	4
	Male	12	10	5th Graders	19
Mountain Song Community School	Total	27	19	2nd Graders	11
	Female	10	9	3rd Graders	8
	Male	17	10	5th Graders	8

In *Table 1*, we show that while Soaring Eagles Elementary respondents were predominantly females, there were 18 males and 10 female respondents at Mountain Song Community School. Additionally, we can see that proportionally more students at Soaring Eagles Elementary attended preschool.

In Table 2, we summarize 8 answers about students' habits at schools and at home that suggest more about the school's and parental involvement in educating students about environment-friendly practices such as recycling, composting, reducing food waste and caring for plants.

Table 2

		Recycle	Compost	Finish Meals	Caring for Plants
Soaring Eagles Elementary	At Home	19	10	36	24
	At School	22	5	13	9
Mountain Song Community School	At Home	25	15	24	18
	At School	25	26	19	25

Overall, the data about student habits shows that Mountain Song Community School actively implements environmental practices. Out of 27 students, 25 recycle and care for plants and 26 students compost at school. These numbers are generally smaller for the same activities at home. In constrast, students from Soaring Eagles Elementary show more environment-friendly behavior at home except for recycling (22 at school, 19 at home). Proportionally, Mountain Song puts more emphasis on pro-environmental practices and the data suggests an overall higher parental involvement in recycling, composting and caring for plants. Another interesting finding is that students from both schools do better at finishing their meals at home. From interviews with school administrators, we know that students at Mountain Song bring lunch and snack from home while students at Soaring Eagles eat lunch in the school's cafeteria.

With a better understanding of our student sample and the nature of our data, we decided to run logit regressions as an intermediate step before treating our data as simultaneous equations model. The 14 logit regressions (one per question on the questionnaire) incorporated all the remaining 13 answers as potential explanatory variables as well as our explanatory variables: AGE, G, S, GRA and PRE. The regression outputs told us more about the nature of responses and the way they affect one another. The following few paragraphs discuss the outcomes of the logit regressions and build towards an identified matrix that we will later use in our regressions

Firstly, the logit regressions allowed us to eliminate several variables and observations from our model because the answers to certain questions showed minimal variation across the student sample. Consequently, there was no need to include them in the model. Although we lost a significant portion of our observations, we still collected some interesting information about the students' environmental awareness and habits *(Table 3).*

Table 3

Do you finish meals at home?	Where does pollution come from?	Which things do we recycle?	We need plants for:	A child picks up a candy wrapper and throws it in the trash.
Yes - 60	Factories and cars -62	Bottles and cans -63	Breathing - 63	Good for the environment - 62
No - 5	Cycling and walking the dog - 3	Spoiled food and candy wrappers -2	Sleeping -2	Bad for the environment - 3

Table 3 represents answers to five questions that we decided to eliminate because of the lack of variation in the data. Finally, this also helps us form an appropriate model with less endogenous variables included in our equations.

In the following section, we will present our regression output and interpret the results.

SECTION 5 - Results

Prior to running our regressions, we have spent a long time examining different regression approaches to capture both the endogenous and binary nature of our data. We needed to build a system of nine equations where each equation has up to five endogenous and five exogenous variables. Additionally, none of variables were continuous and that complexified even the computations even more. As we researched further, we learned about Generalized Structural Equations Model (GSEM). In an ideal setting, this command would setup pathways between individual variables and equations and then, it would run our regressions. However, the setup of a systems with nine interconnected equations proved to be computationally so difficult that Stata kept returning errors when included more than three equations.

Due to these obstacles, we had to turn to Seemingly Unrelated Regressions (SUR) and finally, we were able to regress all nine equations and acquire results. To verify and improve the viability of our results, we firstly checked for statistical problems: multicollinearity, omitted variable bias and heteroscedasticity. We discovered that higher correlation exists between the grade level and the age of students, composting at school and the school of attendance, and caring for plants at school and the school of attendance. Overall, this outcome did not surprise us because the grade level and age of students provide almost identical information unless someone repeated or skipped an academic year. Similarly, the school of attendance has a strong influence on practices and habits established in the institution such as composting and caring for plants. Based on the correlation results, we decided to eliminate the grade variable (GRA), however we opted to keep the rest since the correlation was not as high and theory suggests that these variables are important to our model. Moreover, thinking about potential omitted variables brought about an interesting idea for future research. Theoretically, we could improve the model by collecting data about the student families' socioeconomic background through median income and race/ethnicity. The reason why we did not conduct our survey this way was to make the questionnaires as neutral and anonymous as possible. Additionally, this information would need to be shared with us by the parents or legal guardians and that might lower the rate of parental consent and student participation. Finally, we worked on testing for heteroscedasticity. We found out that the SUR model does not allow to robust our errors while the GSEMs would automatically account for it. Fortunately, the Breusch-Pagan test showed that we fail to reject the null hypothesis that assumes homoscedasticity because our p-value is 0.469.

The following tables and paragraphs will present and analyze our results:

Table 4

Dependent variables	Observations	Parameters	Wald Chi^2	P-value
Recycling at Home	64	9	29.25	0.0003
Recycling at School	64	10	29.99	0.0004
Composting at Home	64	10	53.53	0
Composting at School	64	10	223.84	0
Finishing meals at School	64	8	32.51	0
Caring for plants at Home	64	9	55.18	0
Caring for plants at School	64	9	94.4	0
Spoiled food goes to Compost	64	10	37.53	0
A child eats half an apple and throws in the trash	64	10	36.03	0

As we can see in *Table 4*, we have very high Wald Chi-squared statistics for all nine regressions. This allows us to reject the null hypothesis that all our coefficients are equal to zero and it also suggests that overall, our model does partially explain the variation in our dependent variables. We present our Seemingly Unrelated Regression results below:

Table 5

Dependent variables	Explanatory variables	Coefficients	Z -value
Recycling at Home	Compost at Home	-0.074	-0.68
	Finishing meals at School	**0.163**	**1.48***
	Spoiled food goes into compost	0.047	0.4
	A child eats half an apple and throws it in the trash	**-0.196**	**-1.49***
	Age	-0.006	-0.15
	Gender	0.103	0.96
	Preschool attendance	0.169	1.4
	School of attendance	**0.528**	**4.05*****
	Constant term	0.381	1.03
Recycling at School	Recycling at Home	-0.080	-0.69
	Composting at Home	0.074	0.67
	Composting at School	0.219	1.17
	Caring for plants at School	**-0.385**	**-2.99*****

	A child eats half an apple and throws it in the trash	**-0.221**	**-1.75****
	Age	0.018	0.52
	Gender	-0.124	-1.17
	Preschool attendance	**0.201**	**1.69****
	School of attendance	**0.490**	**2.33*****
	Constant term	**0.573**	**1.62***
Composting at Home	Recycling at Home	-0.122	-1.03
	Composting at School	**0.905**	**5.08*****
	Caring for plants at Home	**0.329**	**2.87*****
	Spoiled food goes into compost	-0.084	-0.71
	A child eats half an apple and throws it in the trash	-0.055	-0.4
	Age	-0.018	-0.45
	Gender	-0.016	-0.14
	Preschool attendance	0.078	0.56
	School of attendance	**-0.431**	**-2.05*****
	Constant term	0.211	0.56
Composting at School	Recycling at School	0.102	1.37
	Composting at Home	**0.332**	**5.12*****
	Caring for plants at School	**0.183**	**2.22*****
	Spoiled food goes into compost	**0.131**	**1.76****
	A child eats half an apple and throws it in the trash	-0.061	-0.74
	Age	0.030	1.22
	Gender	0.067	0.98
	Preschool attendance	**-0.121**	**-1.56***
	School of attendance	**0.648**	**6.45*****
	Constant term	**-0.332**	**-1.47***
Finishing meals at School	**Composting at School**	**0.315**	**1.62****
	Spoiled food goes into compost	**-0.383**	**-3.16*****
	A child eats half an apple and throws it in the trash	**-0.322**	**-2.26*****
	Age	-0.042	-0.99
	Gender	-0.053	-0.44
	Preschool attendance	-0.054	-0.41
	School of attendance	0.094	0.43
	Constant term	**1.219**	**3.11*****
Caring for plants at Home	Recycling at Home	0.021	0.18
	Composting at Home	**0.341**	**3.35*****
	Caring for plants at School	**0.385**	**3.08*****
	A child eats half an apple and throws it in the trash	**-0.363**	**-2.87*****
	Age	0.023	0.66
	Gender	0.044	0.4
	Preschool attendance	**0.384**	**3.16*****
	School of attendance	-0.136	-0.87

	Constant term	0.101	0.28
Caring for plants at School	**Recycling at School**	**-0.302**	**-3.01*** **
	Composting at School	**0.314**	**2.07*** **
	Caring for plants at Home	**0.291**	**3.05*** **
	Spoiled food goes into compost	**-0.198**	**-2.08*** **
	Age	-0.004	-0.13
	Gender	-0.133	-1.44*
	Preschool attendance	-0.010	-0.08
	School of attendance	**0.414**	**2.54*** **
	Constant term	**0.485**	**1.61***
Spoiled food goes into compost	Composting at Home	-0.164	-1.32
	Composting at School	**0.436**	**2.12*** **
	Finishing meals at School	**-0.379**	**-3.2*** **
	Caring for plants at Home	0.084	0.65
	A child eats half an apple and throws it in the trash	**-0.314**	**-2.28*** **
	Age	**0.080**	**2.01*** **
	Gender	-0.051	-0.45
	Preschool attendance	-0.176	-1.27
	School of attendance	**-0.321**	**-1.54***
	Constant term	0.441	1.11
A child eats half an apple and throws it in the trash	Composting at Home	-0.067	-0.61
	Composting at School	-0.089	-0.49
	Finishing meals at School	**-0.185**	**-1.75****
	Caring for plants at Home	**-0.248**	**-2.19*** **
	Spoiled food goes into compost	**-0.245**	**-2.29*** **
	Age	0.044	1.19
	Gender	-0.081	-0.81
	Preschool attendance	0.104	0.83
	School of attendance	**0.455**	**2.55*** **
	Constant term	**0.624**	**1.8****

$*p = 0.15$ $**p = 0.10$ $***p = 0.05$

Table 5 provides the full analysis of our data through the SUR models. Determined by our logit regression outputs, we now have nine dependent variables, each explained by a different set of variables. After eliminating *Grade* due to multicollinearity, the four truly exogenous variables appear in every equation (*Age, Gender, Preschool attendance, School of attendance*).

Based on the results, we can accept our hypothesis: "Environmental education, as part of elementary school program, has a positive and relevant effect on both students' environmental awareness and their environment-friendly habits." We can see that the coefficient on *School of attendance* is very relevant except for the habits of *Finishing meals at school* and *Caring for plants at home* where the z-values are too low for us to reject the null hypothesis that the coefficients equal zero. A possible explanation to that might be the schools' different meal plans, where Mountain Song does not provide lunches and Soaring Eagles Elementary does. Additionally, the habit of *Caring for plants at home* is mostly determined by the parents rather than the school. Moreover, we have mostly positive coefficients associated with the School of attendance except for the students' answers to *Spoiled food goes into compost* and *Composting at Home.* Unfortunately, we believe that many students struggled with comprehending the question about *Spoiled food* and thus, our answers may be biased. The positive coefficients on *School of Attendance* between 0.41-0.65 mean that for each additional student who attends Mountain Song Community School (=1) causes an 0.41-0.65 increase (dependent on the question) in having environment-friendly answers (=1) to a question about environmental habits and awareness. Having characterized Mountain Song Community School's practices and program as the more environment-friendly one, the above discussed results support our hypothesis.

Another interesting and relevant outcome of this study is the interactions between certain answers and *Composting at Home/School*. We find that these habits mutually impact one another. In both cases, we fail to reject the hypothesis that the coefficients equal zero with more than 95% confidence for regressions with dependent variables *Composting at Home* and *Composting at School.* Furthermore, the results suggest that per each additional student who composts at school, we have approximately 0.9 increase in *Composting at home*, too. The coefficient is significantly lower in the other direction of causality (0.33). We believe that, in reality, these results also show that parents select schools according their beliefs and principles.

Surprisingly, *Age* and *Gender* seem to have minimal to no impact on the students' habits and environmental awareness. Similarly, *Recycling at Home* and *at School* does not show any relevant influence on the majority of students' answers. The only interaction we observe is the -0.3 on *Recycling at School* in the regression with *Caring for plants at School* as dependent variable. This is rather counterintuitive and we think that having more data might have altered this result.

There are few other results that do not logically fit based on theory. For instance, knowing that it is bad for the environment if *A child eats half an apple and throws it in the trash* seem to negatively impact several other answers/habits. Again, we may blame the poor phrasing of the question for these strange regression results.

In attempts to improve our model and account for endogeneity between our dependent variables, we also worked toward creating a Generalized Structural Equations Model (GSEM). After working around some syntax errors and simplifying the model, we managed to successfully run a system of three equations.

<u>Table 6</u>

Dependent Variable	Explanatory Variables	Coefficients	Z-value
Recycling at Home	Finishing meals at School	0.878	1.16
	Spoiled food goes into Compost	0.364	0.4
	A child eats half an apple and throws it in the trash	-0.937	-1.15
	Age	0.936	1.14
	Grade	-0.995	-1.17

	Gender	0.881	1.09
	Preschool Attendance	**1.243**	**1.43***
	School of Attendance	**3.204**	**3.04*****
	Constant term	-6.336	-1.32
Recycling at School	Recycling at Home	-0.385	-0.46
	Composting at Home	0.412	0.43
	Composting at School	0.323	0.22
	Caring for plants at School	-1.350	-1.4
	A child eats half an apple and throws it in the trash	**-1.303**	**-1.47***
	Age	-0.616	-0.76
	Grade	0.9358284	1.1
	Gender	-0.504	-0.59
	Preschool Attendance	1.081	1.27
	School of Attendance	**3.779**	**2.08*****
	Constant term	3.144	0.67
Composting at Home	Recycling at Home	-0.010	-0.01
	Composting at School	**2.274**	**1.76****
	Caring for plants at Home	**1.654**	**1.94*****
	Spoiled food goes into Compost	-0.504	-0.67
	A child eats half an apple and throws it in the trash	-0.711	-0.78
	Age	**-1.943**	**-2.28*****
	Grade	**2.243**	**2.36*****
	Gender	-0.201	-0.27
	Preschool Attendance	0.233	0.24
	School of Attendance	0.421	0.27
	Constant term	**7.026**	**1.58***

*$p = 0.15$ **$p = 0.10$ ***$p = 0.05$

As in SUR, *School of attendance* plays a very important role and it is likely, that if we were able to run the entire system of nine variables, we would accept our hypothesis that the school's principles and environmental programs do positively impact their students' environment-friendly habits and increase their environmental awareness.

As opposed to SUR, the coefficients in GSEM are overall significantly higher. Counterintuitively, the results show that *Age* has a relevant negative impact on *Composting at Home* while *Grade* impacts it positively.

Finally, all of our results support our hypothesis and reveal some intuitive and believable pattern. At the same time, due to statistical limitations and the rather low turnout in data collection, some results are very strange and counterintuitive. The following and last section will focus on the implications of and the reflections on our research.

SECTION 6 - Conclusions and Implications

In line with the hypothesis, we show that the principles and programs in elementary schools do affect the demonstrated knowledge about environmental awareness and the environment-friendly habits. In order to progress towards an environmentally more sustainable future, based on our research, we would recommend working towards implementing more environment-friendly practices and programs already in elementary schools. Surprisingly, the SUR model showed that *Age* of the students had almost no relevant impact on any of our dependent variables. This may suggest that our theory about habit formation of environment-friendly practices in children does not apply. However, we cannot evaluate the relevance of the modified Becker & Murphy model because we did not survey the same individuals in different time periods. For future research, repeating the research and surveys would provide more possibilities to test the hypothesis through more appropriate models.

We also discovered how important it is to carefully phrase each question, especially when we survey children of different ages. Although we received advice from a specialist in early childhood education and altered our questions accordingly, we still potentially struggled with biased data because students would misunderstand one or more questions. If we were to repeat our data collection, we would try to firstly use a small testing student group to see whether they understand the questions and only then, we would formally collect our data. Furthermore, our research would benefit from knowing more about the students' socio-economic background and their family's involvement in environmental education. This way we could better understand which habits have been initiated by the parents/families, and which ones were introduced to the students by the teachers. The main problem, associated with asking more personal and sensitive questions during our bachelor thesis research, was that we would have first needed to build up credibility and gain the families' trust. Consequently, we might risk losing some of our student sample in terms of both response rate and demographic variety as some parents or legal guardians may feel uncomfortable sharing their family median income and race with an undergraduate student.

To conclude, we believe that our research study set a base for potential research in the fiels of applied environmental education in the United States of America. We showed that there exists a correlation between environment-friendly habits, environmental awareness and the school of attendance. Since a noticeable part of the contemporary society focuses on preservation of the environment and studies human-induced climate change, we contribute to the movement by exploring the effectiveness of educating new generations as a tool towards more sustainable future.

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