Experimenting with a novel sustainability education course for secondary schools: the D.Game, YOUth play the future

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Abstract

This paper reports the preliminary findings of an ongoing research funded by EIT Climate-KIC that aims at creating a novel sustainability course for secondary schools in Finland, Spain, and Italy, and experimenting with a participative governance model for schoolchildren. The study analyses two short new sustainability courses for secondary school teachers and students in order to compare their impact on some of the key precursors of environmental behaviour and leadership. On the one hand, the D.Game focuses on cultural values, collaboration and hope as levers of change for sustainability. On the other, the Young Innovators standard training focuses on systemic innovation with the guidance of visual tools for systems thinking.

We investigated the impact of the D.Game/standard Young Innovators courses on teachers (N=142) and students (N=121) through a randomized controlled trial and a pre-experiment (one-group pre-post design) respectively. The initial results of the teachers study show that the D.Game training was more effective in promoting a change in self-transcendence values whereas the standard Young Innovators programme was more effective in reducing positive attitudes towards the exploitation of natural resources. On the other hand, the students study revealed that the D.Game program was effective in reducing positive attitudes towards the exploitation of natural resources among the youngest students (Age ≤14).

Keywords: Environmental attitudes, environmental behaviour, leadership, secondary education, sustainability education, values.

1. Introduction

Since Bybee (1991) denounced the situation of planetary emergency due to human impact on the planet, there have been many appeals from the most diverse organizations to accelerate the pace of the transition to sustainability focusing on education as one of its main pillars. The Earth Summit in Rio de Janeiro in 1992 was a turning point in the recognition of the role of education as one of the key levers of societal change tackling global sustainability issues (Agenda 21, 1992).

The summit urged educators at all levels and in all disciplines to help citizens acquire an adequate vision of the problems and challenges affecting humanity and thus participate in the necessary decision-making processes (Vilches and Gil Pérez, 2009). In this sense, secondary school students are a particularly relevant target group, as the decisions concerning their lives and future behaviours have long-term effects. Moreover, this group will be part of the decision and policymaking in a few years' time.

Our paper contributes to the literature on the role of education for sustainability, by exploring how a more holistic approach to sustainability education can contribute to the emergence of a new set of values, attitudes and leadership skills that support the sustainability transition. To this end, we investigated whether a short new sustainability training for secondary school teachers and students promoting cultural change and self-empowerment has a higher impact on some of the key precursors of environmental behaviour and effective leadership than a training based solely on a systems innovation approach. We choose a comparison with systems innovation approach because of its popularity among environmental educators and in education for sustainability. The key antecedents of pro-environmental behaviour we consider in this study include values and environmental attitudes, whereas, for effective leadership we evaluate the impact on self-esteem and self-efficacy.

Values and attitudes have been found to be important determinants of environmental behaviour in numerous studies (e.g. Klöckner, 2013, 2019; Bogner, 2017) whereas Self-efficacy and Self-esteem have been associated with effective leadership (e.g. Hill and Ritchie, 1977; McCormick, 2001). To fulfil our research goal, we conducted two parallel studies. In the first study, 142 teachers were randomly separated into two groups: an experimental group (N=70) and a control group (N=72). The experimental group followed the D.Game training program, and the control group a sustainability training provided by EIT Climate-KIC, a Knowledge and Innovation Community (KIC), working to accelerate the transition to a zero-carbon economy. In the second study, one group of students (N=121) was recruited and assigned to the D.Game training program and, like in the previous case,

evaluated before and after the training through questionnaires with multi-item psychometric scales. The preliminary results of these ongoing studies are presented in this paper. The remaining part of this article is organised as follows: Section 2 introduces some relevant literature on education for sustainability. Section 3 presents the research design and psychosomatic scales utilized. Section 4 includes the preliminary results and Section 5 a brief discussion of the relevance of the findings.

2. Education for sustainability

The United Nations proclamation of the Decade of Education for Sustainable Development 2005-2014 (DESD), also originally called Education for a Sustainable Future, was undoubtedly one of the main global efforts in integrating the principles, values and practices of sustainable development into all aspects of education and learning. This process requires the involvement of all education levels, both formal and non-formal education.

The final report of the Decade showed much evidence of the growing international dissemination of the education for sustainable development approach (UNESCO, 2014). Although still insufficient, given the worsening planetary situation, sustainability has been integrated into education and, in particular, in higher education institutions for years. Good practices can be found in many countries and on all educational levels, as it can be seen in the comprehensive review commissioned by UNESCO (Tilbury, 2011) and in the report of the Worldwatch Institute (2017).

In 2015, the United Nations Summit in New York adopted the document "Transforming our World: The 2030 Agenda for Sustainable Development" (UN, 2015), articulated through 17 Sustainable Development Goals (SDGs) and 169 targets to be implemented in the period 2016-2030. This Agenda sets out 17 interrelated goals to address a wide range of social, economic, and environmental challenges. Achieving them will require profound transformations in the actions and behaviours of citizens, as well as in the functioning of societies and economies. Regarding SDG 4 (Quality Education), target 4.7, refers to students acquiring the knowledge and skills needed to promote sustainable development. In this respect, it is obvious that not only students' education, but also teacher training has an essential role to play in contributing to the achievement of this goal.

Rieckmann (2018) reviewed a large body of studies to identify key competencies in sustainability. These include systems thinking, anticipatory, normative, strategic, collaborative, critical thinking, self-awareness, and integrated problem solving. Considering both the 2030 Agenda and the main key competencies in sustainability proposed by Rieckmann (2018), it appears essential to examine individual and cultural values to determine the extent to which we are contributing to a society that

is ready to make the necessary paradigm shift to sustainability. In this sense, values are used in the context of environmental concern and people's motivation for action, including not only the ecological, but also the social and cultural dimension of sustainable development. Horlings (2015) highlights that there is an inner dimension of the sustainability transition meaning that personal and cultural values are essential precursors of societal transformation. This resonates with Maiteny (2009) who studied the importance of reflection on one's motives, feelings, aims, priorities, and self-knowledge to enhance understanding of one's role in societal transformation and generate a sense of meaningfulness that can contribute to both personal and ecological well-being.

When discussing the importance of values, Schwartz's Theory of Basic Values (1994) needs to be highlighted for its extensive use in environmental education research. It lists ten universal values (defined according to the motivation or goal that underlies them) which are classified according to four major dimensions: openness to change, self-transcendence, self-enhancement, and conservation. Self-transcendence values have been found to be positively correlated with self-reported environmental behaviour (Karp, 1996). On the other hand, self-enhancement values are negatively correlated with both self-reported behaviour and environmental attitudes (e.g., Stern et al., 1995).

Attitudes towards nature and the environment have been studied through the Two-dimensional Model of Environmental Values (2-MEV, Bogner and Wilhelm, 1996). This model comprises two value-based factors called utilization and preservation, the first reflecting an anthropocentric concern and the second, an eco-centric concern. Preservation is used to evaluate preferences towards conservation of nature and the environment, whereas utilization is used to measure preferences towards the utilization or exploitation of natural resources. This two-dimensional structure amply demonstrated its reliability within a sample of 6,379 teachers in 16 countries (Munoz et al., 2009), as several diverse previous studies also showed (Schneller et al., 2015; Castéra et al., 2018, etc.). The 2-MEV model has been used to investigate environmental attitudes of both in-service and pre-service teachers. In a recent study involving 1,109 teachers and students from Sweden and France using the 2-MEV model, it was found that they both had prevalently eco-centric attitudes, which possibly indicates a predominant preference towards nature conservation (Nyberg et al., 2020).

Focusing on students, there is a need for transformative leadership and climate action from the young generations. In this respect, perceived self-efficacy and self-esteem are important not only for academic performance but also for effective climate leadership (Goleman et al, 2002). Leaders are highly self-confident and optimistic individuals with acute organizational awareness, and they are meant to catalyse, inspire, communicate, create, achieve, empathize, and support (Goleman, 1998). All these qualities related to emotional intelligence can be developed through accurate self-

assessment, reflection, and experience (Reed, 2005) and should be analysed and encouraged in the educational system.

Focusing on the studies carried out with students, Tsevreni (2011) presents an alternative approach to environmental education that focuses on children's ideas and action rather than scientific knowledge. The approach is based on children's willingness and ability to act and participate in their community and environment. His research finds that the children initially expressed a lack of self-confidence and did not display willingness to act. They felt that their voice and their participation in urban planning were not important and would not be taken into consideration by adults. Furthermore, it can be argued that children's denial of action shows that children have a rather low sense of 'self-efficacy' (Bandura, 1997). Self-confidence is very important for the children's empowerment as it helps them to move from denial of action to willingness to act (Tsevreni, 2011). By the end of the educational programme proposed by Tsevreni (2011), children had obtained a new kind of knowledge that is connected to action. Building this knowledge for action is an important component of children's emancipation (Hart, 1992). The knowledge that children obtain is very different to that conveyed through traditional environmental education, which is based on scientific knowledge. The main goal of the children's involvement in their local community was the development of their ability to act, therefore, their knowledge was action-oriented. This kind of knowledge is focused on participatory and action-oriented processes (Simovska & Jensen, 2009). The action model was an attempt to demonstrate that children can develop a willingness and ability to act through the expression and communication of their ideas. It is important to note that the emphasis of Tsevreni's (2011) approach was not on the chosen actions but on the attainment of self-confidence (as well as wellbeing and self-empowerment).

More recent work by Ho (2021) focuses on cooperative learning in high schools, analysing real-world education for sustainability. The study focused on self-efficacy as previous research by Chen et al. (2001) and Sherer et al. (1982) and concluded that sustainability educators should aim for knowledge acquisition through implicit learning and improvement of self-efficacy through explicit learning. These and other studies are aligned with the focus of this research, which stresses the importance of working at the intersection of values, environmental attitudes, self-esteem and self-efficacy when analysing willingness to climate action.

3. Methodology

3.1 Study 1

This study leverages an experimental research design. Randomized Controlled Trials (RCTs) were conducted in three countries (Italy, Spain and Finland) to compare how differences in outcomes between teachers following the D.Game approach (intervention group) compared to teachers following the standard Young Innovators program (control group). We first established a baseline (pretest) measuring the mean score of our instruments before the training started, then we randomly assigned the participants to the control and intervention group, and finally measured the mean score of the same instruments after the training (posttest).

The research conducted on the teachers was designed with the purpose of comparing the impact of a three-week online training course (9 hours plus individual work) on teachers' emotions and values as antecedents of environmental behavior. Moreover, the research aimed to understand whether there existed any differences in terms of impact on environmental attitudes and systems thinking. The participants were assigned randomly to one of two groups, where Group A represents the intervention group and Group B the control group.

Group A followed the The D.Game course, which stems from the project, "D.Game: YOUth play the future". The D.Game is a course based on game-like activities to empower teachers and students with skills and capabilities for co-creating a more equitable, inclusive and carbon-neutral society. Its educational modules combine technical knowledge on sustainability transitions with innovative tools of involvement, teamwork, and facilitation. The D.Game sustainability course focuses on cultural values, collaboration, and hope as levers of change for sustainability.

Group B instead followed a standard training course provided by the Young Innovators programme. The programme was launched by EIT-Climate KIC, Europe's largest public-private innovation partnership focused on climate innovation to mitigate and adapt to climate change and has been running since 2018. This programme is implemented by a variety of partners in different European countries in the context of secondary education, with the main focus on teacher training. Depending on the expertise of the partners, the training is implemented through different approaches, bearing in mind the basic aim of generating systemic innovation with the guidance of visual tools for systems thinking.

We made sure that in all the countries the Young Innovators training was delivered in the same way to allow comparison. The data were collected through pre-post questionnaires with multi-item psychometric scales that were translated back and forth (from English to the local language and from the local language back to English) by native speakers. Our hypothesis is:

H$_0$: There is no difference in the post-treatment scores of self-transcendence values (SELF-TRANSCEN) and attitudes towards exploitation of natural resources (UTIL) between intervention and control group when controlling for pretest scores.

3.1.2. Instruments

Although in this paper we report only the results concerning values and environmental attitudes, the instruments utilized for the teachers' questionnaire included various scales that were previously built and validated. They are:

- The Short Schwartz's Value Survey gives insight in the ten broad values, each named after its central goal (Struch et al., 2002). People in virtually all cultures implicitly recognize these values. In this paper, we concentrate in particular on self-transcendence values. Therefore, our dependent variable is named **SELF-TRANSCEN**.

- The Positive and Negative Affect Schedule or (PANAS) is a scale that consists of different words that describe feelings and emotions. It was developed by Watson et al. (1988). In our questionnaire, we use PANAS-SF, which is a more concise version of the original measurement.

- The Environmental Attitudes Inventory (EAI) was developed from a pool of 200 scale items, many of which were drawn from existing environmental attitude measures, to measure environmental attitudes (Sutton & Gyuris, 2015).

- Two Major Environmental Value model (2-MEV) as an anchoring scale for EAI, in case the first would not turn out to be reliable with the expected number of participants. In fact, EAI utilizes two elements for each sub-scale one of which is the reverse question; the scale may not be reliable for smaller samples. The 2-MEV scale includes two components, utilization, and preservation of natural resources (PRE). We call our dependent variable for utilization, **UTIL**.

- Systems thinking scale by Watson et al. (1988). Systems thinking is defined as "a trans-disciplinary construct that has been promoted as a means of being able to better comprehend and mitigate complex social-ecological dilemmas".

- Willingness to act (for the climate) by Tobler et al. (2012). This scale measures people willingness to act in three different spheres, mobility, low-cost behavior, and indirect behavior.

The teachers were asked to state how important each of the 10 values of the Short Schwartz's Value scale were important for them. Following previous studies, the responses were ordered on a LIKERT

scale that ranged from -1= completely opposed to my values to 7= Of supreme importance. For environmental attitudes and the remaining scales, the responses were ordered on a scale that ranged from 1= I completely disagree to 7=I completely agree.

The data obtained through the questionnaire were analyzed with the support of SPSS 27. The analysis proceeded in three stages; first principal component analysis (PCA) was conducted to reduce the dimensionality of our large dataset. When the main components were identified, a total score for each component of the scale was calculated. The scoring was obtained by calculating the mean value of the items associated to each component or, when available, according to the specific instructions given for the scoring of the scale. Finally, an ANCOVA test was run to explore group differences while controlling for the pretest score.

2.2 Study 2

Study 2 follows a quasi-experimental research design. A different research design for the students´ study was chosen due to the lack of time and resources to conduct RCTs. Therefore, a one-group pretest–posttest design was run to evaluate the impact of the D.Game pilot project on secondary school students from Spain and Italy. The difference between this design and the one adopted in the teachers´ study is that in the former there is no randomization and control group. Hence, the second study included only a pre-post measurement of the mean score of our instruments.

2.2.1 Instruments

For the students, a different questionnaire was used to focus attention on other aspects that were considered more relevant for sustainability education aimed to young people. Besides measuring impact on environmental attitudes like in the teachers´ study, we also wanted to measure the impact of our experimental training program on some key precursors of effective leadership. Therefore, in addition to the the 2-MEV scale, the questionnaire included the following two other scales:

- The General Self-Efficacy (GSE) scale that is correlated to emotion, optimism, work satisfaction. Negative coefficients were found for depression, stress, health complaints, burnout, and anxiety (Schwarzer & Jerusalem, 1995).
- The Rosenberg Self-Esteem (SE) scale measures global self-worth by measuring both positive and negative feelings about the self-esteem (Rosenberg, 1965).

For the GSE scale, students were asked to state how true certain statements were for them, the responses were ordered on a LIKERT scale that ranged from 1=Not at all true to 4= Exactly true. For

the SE scale, the responses were ordered on a LIKERT scale that ranged from 1= Strongly agree to 4=Strongly disagree. In this case, the scoring was obtained by following the specific instructions for the scoring of these scales. As in the case of the students study we did not have a randomized experiment, the score difference method was applied to evaluate post minus pre intervention variations.

4. Results

1.1 Study 1

1.1.2 Descriptive statistics

Seventy teachers were recruited for the intervention group and seventy-two for the control group. They were from three countries (50% Italy, 40.2% Spain, and 9.2% Northern Europe). Their average age was 48.4 years. The female teachers represented 83.8% of the sample, whereas male teachers were 16.2%. Most of the teachers were teaching in lower secondary schools (53.5), however, the sample also included a small number of teachers from elementary schools (13.4%). As for their work experience, 64.7% had been working for ten or more years and were by large tenured teachers (64.7%). Table 1 below shows the subjects taught by the teachers.

Table 1. Subjects taught by the teachers.

Subject	Percent
Mathematics/Physics/Life sciences/Chemistry	43.6
History/ Geography	16.9
Native language/ Ancient languages	14.1
Foreign language	1.6
Applied science /IT	9.9
Special educational needs teacher	8.5
Art	5.6
Religion	2.1
Philosophy	.7
Other	25.4

Table two below, shows the mean and standard deviation for the key variables investigated in the ANCOVA test.

Table 2. Mean and Standard Deviation of the key variables investigated.

		Group				
		YI			D.Game	
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
UTIL_Pre	72	2.41	.840	70	2.063	.807
UTIL_Post	72	**2.210**	.903	70	2.220	.917
SELF-TRANSCEN_Pre	72	7.790	1.366	70	7.874	1.812
SELF-TRANSCEN _Post	72	7.765	1.387	70	**8.388**	1.636

1.1.3 Principal component analysis of Schwartz values and 2-MEV scales

Before running the ANCOVA test, Principal Components Analysis (PCA) with Oblimin rotation was conducted to assess how the two dependent variables, SELF-TRANSCEN values and environmental attitudes towards UTIL of natural resources, clustered. The suitability of PCA was assessed prior to analysis. Inspection of the correlation matrix showed that all variables had at least one correlation coefficient greater than .30. The overall Kaiser-Meyer-Olkin (KMO) measure was .797 for the Schwartz values scale and .660 for the 2-MEV scale. Bartlett's test of sphericity was statistically significant ($p < .0005$), indicating that the data was likely factorizable.

For the initial extraction of the components, the Eigenvalue and percentage of variance were checked. When the number of factors initially extracted were different from those that had been confirmed in previous studies, a parallel analysis was run. Subsequently, factor extraction was forced on the number of factors identified and a simple structure obtained. In the case of the Schwartz's scale one item (Self-direction) was left out from the analysis due to poor loading. However, this did not influence the score of the dependent variable SELF-TRANSCEN as the score is determined by the items loading on the second component. In addition, one item from the UTIL component of the 2-MEV scale was not considered due to poor loading.

The PCA identified two components for the Schwartz values scale and two for the 2-MEV scale, which is in line with previous studies. Component loadings and communalities of the rotated solution are presented in Table 3 and 4. Internal reliability analysis was conducted through Cronbach's alpha. As Table 4 shows, the UTIL component of the 2-MEV scale had a low Cronbach's alpha .506, which indicates that the internal reliability of the construct is questionable. Conventionally, Cronbach's alpha values above .70 are considered good.

Table 3. Component loadings and communalities for the Schwartz values scale.

	Component Loading		
	CONSERV	SELF-TRANSCEN	Communality
Items			
Hedonism	**.895**		.591
Achievement	**.851**		.598
Power	**.68**		.592
Stimulation	**.669**		.364
Benevolence		**.85**	.498
Tradition		**.752**	.722
Conformity		**.72**	.591
Universalism		**.617**	.364
Security		**.512**	.540
Eigenvalues	3.673	1.542	
% of variance	40.818	17.137	
Cronbach's Alpha	.815	.739	

Table 4. Component loadings and communalities for the 2-MEV scale.

	Component Loading		
	PRE	UTIL	Communality
Items			
Q33	**.689**		.317
Q31	**.675**		.299
Q32	**.629**		.365
Q34	**.571**		.246
Q30	**.547**		.372
Q27		**.603**	.311
Q29		**.592**	.498
Q25		**.544**	.391
Q26		**.514**	.472
Eigenvalues	2.194	1.399	

| % of variance | 21.943 | 13.999 |
| Cronbach's Alpha | .613 | **.506** |

1.1.4   ANCOVA test

To determine whether the D.Game training (intervention) would be more effective than the standard sustainability program provided by the Young Innovators program (control), a one-way ANCOVA test was conducted to assess posttest differences in teachers' self-transcendence values and environmental attitudes. Before proceeding with the actual ANCOVA test, all the basic assumptions for this test were checked. The preliminary analysis showed that there was a linear relationship between pre- and post-intervention levels of self-transcendence values and environmental attitudes for each group, as assessed by visual inspection of a scatterplot. Moreover, there was homogeneity of regression slopes as the interaction term was not statistically significant, $F(1. 138) = .713$, $p = .40$ and $F(1. 138) = 3.067$, $p = .082$ respectively.

The standardized residuals for the intervention and for the overall model were normally distributed, as assessed by Shapiro-Wilk's test ($p > .50$), in the case of self-transcendence values but not in the case of the 2-MEV scale. In fact, for the UTIL component, the data was not normally distributed both for intervention and control group. However, as the data was only mildly skewed and the ANCOVA test is considered fairly robust to deviations from normality, it was decided to carry on with the test. Homoscedasticity and homogeneity of variances was assessed by visual inspection of a scatterplot and Levene's test of homogeneity of variance, $p = .064$ and $p = .326$, respectively. To determine if there were significant outliers, the data was inspected for cases with standardized residuals greater than ±3 standard deviations. Two outliers were found for the UTILZ component of the 2-MEV scale but, as these did not affect the results, they were not removed from the data.

The results of the ANCOVA test for self-transcendence values show that there was a statistically significant difference in post-intervention mean score of self-transcendence values between intervention and control group, $F(1. 139) = 8.415$, $p < .05$ partial $\eta2 = .057$. Post-intervention mean scores for self-transcendence values were statistically significantly greater in the intervention group than in the control group (mean difference of 0.573), see also Table 4 and Figure 1. On the other hand, the results of the ANCOVA test for environmental attitudes revealed that there was a statistically significant difference in post-intervention mean score of UTIL between control and

intervention group, $F_{(1, 139)} = 4.343$, $p < .05$ partial $\eta^2 = .030$. Post-intervention mean scores for UTIL were statistically significantly smaller in the control group than in the intervention group (mean difference of .266), see also Table 5 and Figure 2. These findings indicates that whereas the D.Game training was more effective in increasing self-transcendence values, the Young Innovator programme resulted more effective in decreasing positive attitudes towards the utilization of natural resources. Therefore, the null hypothesis (H_0) that there are no differences between intervention and control group when controlling for pretest scores is rejected.

Table 4. Unadjusted and adjusted means and variability for post intervention self-transcendence values.

	N	Unadjusted		Adjusted	
	N	M	SD	M	SE
Control (Young Innovators group)	72	7.76	1.38	7.79	.13
Intervention (D.Game group)	70	**8.38**	1.63	**8.36**	.14

Note: N= number of participants. M= mean. SD= standard deviation. SE= standard error. The self-transcendence cluster was the sum of universalism and benevolence. The final scores were obtained by subtracting the mean score of all the items in the short Schwartz value scales from the self-transcendence cluster.

Table 5. Unadjusted and adjusted means and variability for post intervention attitudes to utilization of natural resources (UTIL).

	N	Unadjusted		Adjusted	
	N	M	SD	M	SE
Control (Young Innovators group)	72	**2.03**	0.86	**2.08**	.08
Intervention (D.Game group)	70	2.41	0.91	2.35	.09

Note: N= number of participants. M= mean. SD= standard deviation. SE= standard error. The UTIL score was obtained by calculating the mean of the items loading on the first component of the 2 MEV-scale.
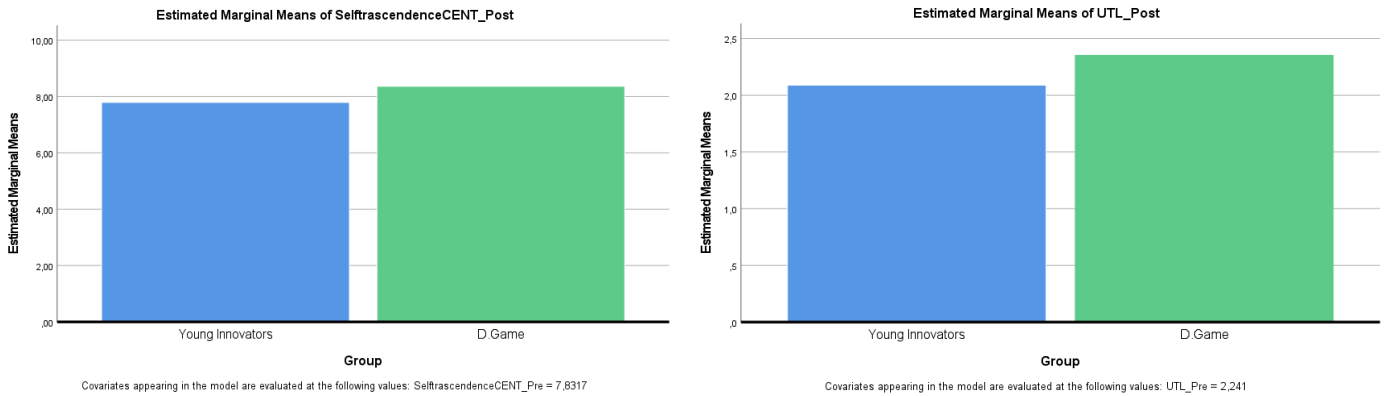
Figure 1 and 2. Estimated marginal means for self-transcendence and utilization of natural resources.

1.2 Study 2

1.2.1 Descriptive statistics

In total N=121 pupils from Spain and Italy (60% and 40%, respectively) participated in the pupils' survey. Male students represented 51.2% of the sample whereas female students were 47.1%. The age range was 13-19 and the mean age was 15. The country mean age was 16 for Italy and 14 for Spain. Table 6 shows the Mean and Standard Deviation for the key variable investigated.

**Table 6**. Mean. Standard Deviation of the key variables investigated.

Variable	N	Mean	Std. Deviation
UTIL_Pre	121	2.917	.945
PRES_Pre	121	5.163	1.060
GSE_pre	121	29.355	4.866
SE_Pre	121	21.512	5.780
UTIL_Post	121	2.793	.986
PRES_Post	121	5.206	1.048
GSE_Post	121	29.743	5.561
SE_Post	121	21.140	6.102

1.2.2 Wilcoxon signed-rank test

Because the data from the student survey were skewed for most of the dependent variables. A Wilcoxon signed-rank test was conducted to determine any post intervention effect of the D.Game training program on students. Before running the test, the main assumptions were checked. The

preliminary analysis showed that the difference scores were approximately symmetrically distributed, as assessed by a histogram with superimposed normal curve.

The results of the test Wilcoxon signed-rank test showed that posttest scores for the entire sample (N=121) were non-statistically significantly higher than pretest scores. However, when checking for score changes in subgroups, the test revealed that for the younger students (Mdn ≤14) the median posttest scores for GSE were statistically significantly higher than the median pretest scores, Z = 2.01. p < .044. As Figure 3 shows, the number of cases that had a positive difference on the posttest was higher that the number of cases with a negative difference. In addition, the test revealed that the median posttest scores for UTIL were statistically significantly lower that the median pretest scores. Z = -2.49, p < .013. Figure 4 indicates that the number of cases that had a negative difference on the posttest was higher that the number of cases with a positive difference. This suggests that the D.Game intervention increased General Self-efficacy while decreasing positive attitudes towards the utilization of natural resources in younger students (Mdn Age ≤14).
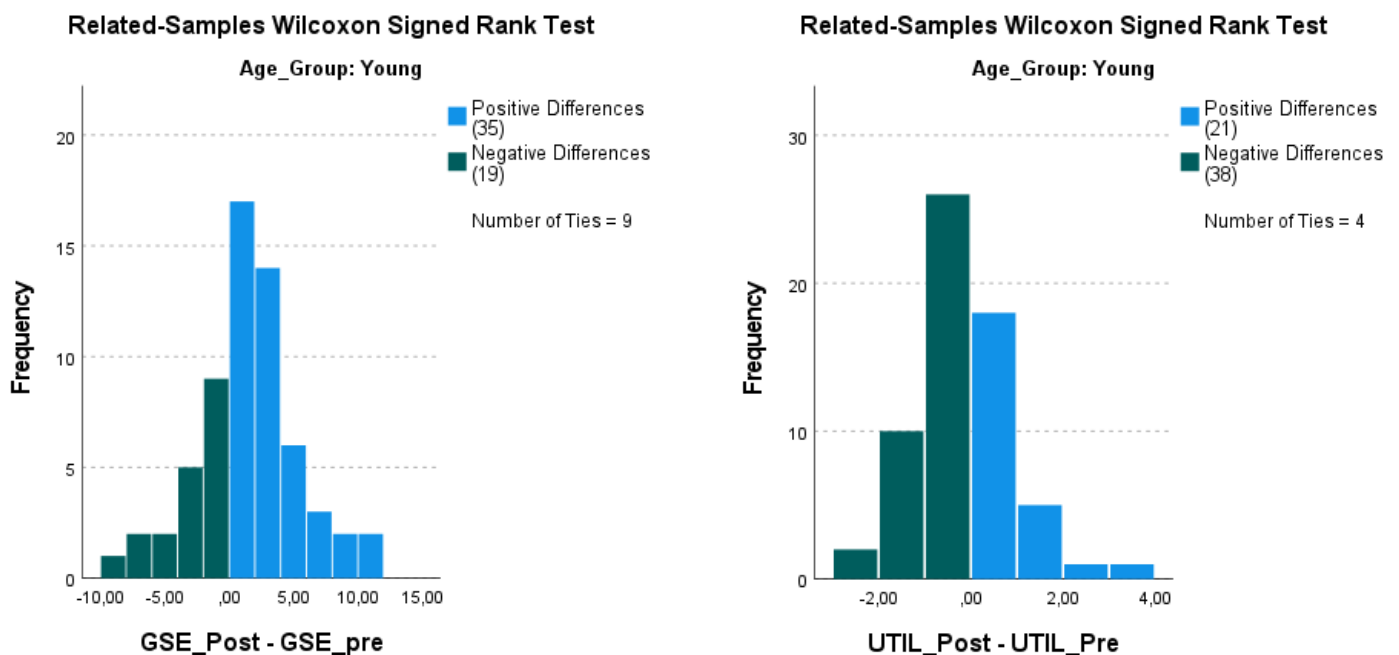
Figures 3 and 4. Results of Wilcoxon Signed Rank Test for General Self-Efficacy and UTILIZ of natural resources in young students (Mdn ≤14). **Note**: The horizontal axis shows the difference between posttest and pretest scores.

As the initial analysis of the data through the Wilcoxon Signed Rank Test revealed that the experimental sustainability training might have influenced younger and older students differently, group differences for GSE and UTIL were formally explored through a Mann-Whitney U test. In

order to assess possible group differences, we utilized the difference score (posttest minus pretest) as this method is unaffected by the presence of non-randomized differences between groups (Jamieson. 2004). Therefore, a Mann-Whitney U test was run to determine if there were statistically significant differences in the GSE and UTIL change scores of younger and older students. The test showed that GSE change scores for younger student (mean rank = 66.96) were almost statistically significantly higher than those for older students (mean rank = 54.53), U = 1451.50, z = -1.957, p = .050. On the other hand, UTIL change scores for younger student (mean rank = 54.52) were statistically significantly lower than for those of older students (mean rank = 68.04), U = 1418.50. z = -2.125, p = .034. This confirms the initial findings of the Wilcoxon Signed Rank Test and indicates that, at least for UTIL, the D.Game training may have been more effective for younger students.
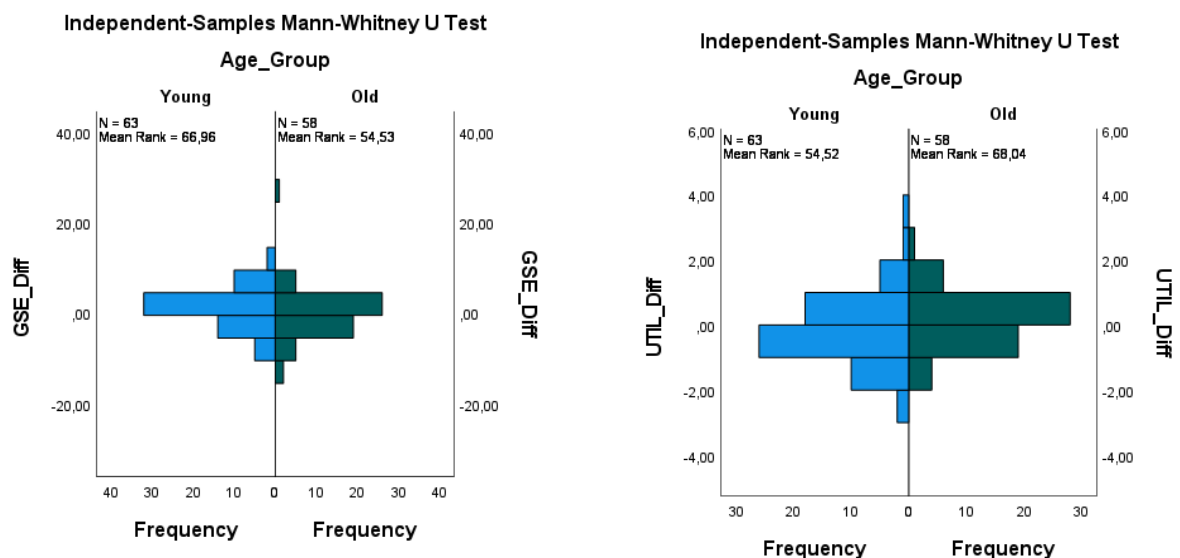
Figures 5 and 6. Results of Mann-Whitney U test for General Self-Efficacy and UTIL of natural resources in young students.

5. Discussion and preliminary conclusions

Based on our preliminary results, we found that our experimental sustainability training, the D.Game, was more effective than a training focussing on systems innovation in eliciting a change in self-transcendence values. This is an interesting finding as many environmental programs come with an assumption that by learning the interconnections between the parts of a system will imply the adoption of a set of values that are more conducive to systemic change. This may not necessarily be the case. As the preliminary results of the study showed no statistically significant differences between the intervention and control group in terms of systems thinking, and considering the importance of values as predictors of environmental change, the D.Game intervention has more potential for shifting values

and at the same time promoting systems thinking. On the other hand, the control group, appeared to be more effective in reducing support for utilization of natural resources. Is important to bear in mind that this result needs to be taken with caution due to the poor Cronbach's alpha of the UTIL component. Therefore, further investigation needs to be carried out before drawing any conclusions regarding this aspect. Is also important to remember that the UTIL component of the 2-MEV scale has been further refined to also incorporate a positive or appreciative usage of nature as opposed to an exploitative utilitarian preference (Bogner, 2018), which was not included in our questionnaire. In any case, the results of the students study indicate the good potential of the D.Game program in eliciting changes in UTIL attitudes in young secondary school students. Similar conclusions may be true also for GSE, which in this study was just above the standard level of statistical significance. As a result, future research should investigate through RCTs the impact of the experimental sustainability program investigated in this paper on students through a two-way ANCOVA to determine differences between age groups as well as intervention type.

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