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Promoting environmental sustainability attitudes in Primary School children using creative thinking and ICT

*Barbara Colombo, Federica Danisi, Chiara Valenti**

Abstract

This research tests the efficacy of a video-training in enhancing environmentally sustainable attitudes of Primary School students through the use of creative thinking.

A narrative video-training presented different tasks, linked to the main aspects of creative thinking and focused on sustainability. The research involved 76 children attending to the second year of Primary school, assigned to either the experimental or control group. Both groups were involved in the pre-test and post-test sessions, measuring creativity levels and students' ecological attitudes. The training consisted of 3 meetings when the children watched the videos, and responded to them by performing different creative activities. Results highlighted how, after the training, children's sustainable attitudes improved significantly. The training was also effective to promote children's motivation and creativity per se. Results are discussed with reference to educational applications. Specific limitations are addressed.

Keywords: environment, sustainable attitudes, creativity, empowerment, primary school, video-training

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Theoretical framework

This research presents the application of a training aimed at enhancing environmentally sustainable attitudes of Primary School students through the use of creative thinking and ICT. Back in the Nineties, the United Nations, at the International Conference on Environment and Development (Rio de Janeiro, 1992) set as a major goal the Sustainable Development. This kind of development is defined as answering to present needs, without jeopardising the chance for future generations to answer their needs (World Commission on Environment and Development, 1987).

Hence, we can refer the term “sustainable” to a behavior that is aware and attentive towards a specific natural resource within an ecosystem. United Nation decided to devote the years between 2005 and 2014 to promote an Education to Sustainable Development – highlighting the fundamental role played by education in promote effective environment protection attitudes.

The main goal of this decade is raising people’s awareness – with a special focus on youngest generation – towards the importance of a future that is more respectful of others and of the resources of the planet. To achieve this goal, educators should show a good understanding of issues related to eco-sustainability, in order to correct unsuitable attitudes and behaviors towards the environment.

Studies in this area have shown that educators and students often do not have sufficient knowledge in the field of ecology and that this contributes to the lack of eco-sustainable behavior (Esa, 2010). These studies are inspired by Environmental Psychology, which is a discipline that deals with the interactions and relationships between people and their environment. Environmental Psychology focuses on ecological behavior, exploring different psychological aspects that play a major role in changing it. One of these aspects are attitudes, which can be described as a generic evaluative reaction towards an object, a person, a problem or a behavior (Oskamp, 1977).

Exploring the role of attitudes towards ecological behavior, Gifford (2002) argues that an environmental attitude may depend on the attention and commitment that a person gives to the physical

environment and its protection, improvement or understanding. In particular, the more he/she will be able to deeply understand and share environmental issues, the more his/her attitude will prove to be attentive and protective towards these issues.

In literature we can find several studies focusing on the environmental attitudes of adults, while, concerning children, the research focused mainly on the degree to which they pay attention to ecological issues. It has been shown that pro-environmental attitudes may appear at a relatively early age: before reaching adolescence, many children are able to understand and discuss environmental issues and their mutual relations with ecology, technology and economy. However, it was also shown that the attitudes of young people are much less in favor of the environment when their implementation involves personal sacrifices (Chan, 1996). Kwan and Miles (1998) found that older children exhibit a stronger attention to the environment compared to the younger ones. Considering these findings, the relevance of working with the children in order to strengthening their ecological attitudes is clear.

The second part of this introduction will focus on a presenting the theoretical bases that lead us to select two specific tools to enhance children ecological attitudes: creativity and audiovisual technology.

Creativity is part of the ten Life Skills identified by the World Health Organization (2003). The term refers to a whole range of skills that allow each individual to address the needs of everyday life maintaining a state of mental well-being, adopting positive behaviors and adaptive interaction with others and with the environment (Boda, 2005). They are not dispositional attitudes, but skills that can be refined and improved (Bonino & Cattelino, 2008).

In designing the creative activities proposed within the training, we referred to the WCR (Widening-Connecting-Reorganizing) Model (Antonietti, Colombo & Pizzigrilli, 2011), which provides a unified theoretical model of the concept of creativity, as resulting from three main skills: being able to broaden a perspective (Widening), to connect seemingly unconnected concepts (Connecting), to reorganize properties of a given situation, changing the whole perspective (Reorganizing). Creativity can be a valuable tool to work on important issues, since it

promotes the creation of a non-judgmental environment in which each child can express himself/herself freely.

The second tool we used is linked to ICT: we choose to present the narration through short video clips created specifically with the aim of facilitating the involvement within the narration – the video clips were presented to the children using the LIM. Our choice is supported by several studies that show how the opportunities that new technologies can offer to support the learning experiences are related to environmental issues. For example, in a recent research (Ruchter *et al.*, 2010) children and adults participated in a guided tour focused on the environment, using different media: ICT based presentation improved environmental knowledge. This was true also for the children, who also increased their motivation. A second interesting study involved 1012 adolescents in Hong Kong, and revealed that being subjected to media information related to environmental issues is positively associated with the perception of control over their behavior. This behavior is positively associated with the environmental-intention (Lee, 2011).

The research presented in this paper has, therefore, the aim of using the synergy potential of creativity and ICT-based video narration, to strengthen the development of environmentally sustainable attitudes in children, promoting at the same time the individual responsibility in the implementation of behaviors that are functional to the environmental protection.

A training based on the use of creative thinking will help participants be more aware of their ecological attitudes, and also to be more open to new and more adequate behaviors. These are fundamental prerequisites to guarantee the efficacy of a training that aims at improving eco-friendly behaviors, as discussed previously. Be more aware, open-minded, and willing to apply different perspective or different even unfamiliar behavior is closely linked the creative operations that our training aims to enhance.

Moreover, creativity and attitudes have been already proved to be correlated in primary school children (Schempp, Cheffers & Zaichkowsky, 1983) as well as in adults (McGuire, 1999). Adding ICT will promote the efficacy of the training, as reported in literature findings discussed above, incrementing children's motivation.

Aims and hypotheses

The main aim of this research is to assess the efficacy of a specific training, using creative thinking and ICT based videos to promote eco-friendly attitudes of primary school children.

We aim at assessing the inter-relationship of three variables: the main dependent variable is outcome is the adequacy of children's eco-friendly attitudes. Yet if a positive change happens this will be mediated by the use of creative thinking and by the support of ICT, as detailed in the final part of the introduction.

The second aim is to assess the specific efficacy of this training in strengthening creative skills as presented in the WCR model: broaden a perspective (Widening), connect seemingly unconnected concepts (Connecting), reorganize a perspective (Reorganizing).

The third aim is to assess the efficacy of the training to promote motivation, cooperation and metacognition thanks to the specific features of ICT based audio-visual technologies.

Starting from these aims, we derived three hypothesis:

- Participants assigned to the experimental group will have more adequate and developed ecological attitude after the training;
- The training will enhance children's creative thinking;
- Integrating and enriching the activities with a video narration presented by the LIM, should enhance children motivation and engagement.

Method

Tools

ASSESSMENT OF CREATIVITY

To assess creativity we used Torrance's Parallel Lines test, one of the figural tests of the Torrance Test of Creative Thinking, TTCT (Torrance, 1966). This test, commonly used to assess creativity, is composed of two different sections: the verbal form (7 activity) and the figural form (3 activities), which can be used individually.

The figural sub-test “Parallel lines”, often used as an autonomous test to assess creativity, consists of 30 pairs of parallel lines. Starting from these lines, participants are asked to create interesting, original and elaborated drawings and assign a title to them. Researchers code each drawing, assign four scores related to:

a) Fluidity: the ability to produce numerous ideas in relation to a given situation or a problem. It corresponds to the number of relevant pictures produced by the participant.

b) Flexibility: the ability to change thinking strategy, moving from a conceptual category to another. It is computed by counting the number of categories within which each response can be classified: researchers assign a point for each drawing that belongs to a different category.

c) Originality: the ability to find unusual answers, which hardly others would think of. It is measured by assessing the number of original/uncommon responses. For each picture, researchers assign a score from 0 to 3. The lowest score corresponds to usual and common ideas while the highest to uncommon and original drawings. The total Originality score is obtained by summing the Originality scores of each drawing;

d) Elaboration: the ability to process and develop properly an idea. It is computed by counting the number of details of each response. Researchers count the number of details that are added to each drawing, enriching the basic idea. The total Elaboration score corresponds to the sum of the Elaboration scores of each drawing.

ASSESSMENT OF ECO-FRIENDLY ATTITUDES

In order to evaluate children’s attitudes towards ecological issues, we devised three self-report questionnaires, organized into a narrative format.

The first questionnaire consists of 22 items. Each item presents a daily situation. Children have to choose between two different behaviors – one is eco-friendly, the other one is not. For every behavior, children are asked to rate on a 5-point Likert scale how good versus bad the behavior is for the environment.

The second questionnaire is aimed at valuating children's knowledge about recycling. Different kinds of waste are presented on the left side of the page, while on the right the different waste containers are represented. Children are asked to link every waste type to the right container. Number of right, wrong and missed answers is computed.

The third questionnaire presents a series of unorganized pictures. Children are asked to help the twins to separate those who represent environmentally positive situations/behaviors from those that are either neutral or wrong. Number of correct and wrong answers is computed.

TRAINING

The video narrative consists of 13 short audio-visual clips (presented using the LIM), which have been designed to link together the different activities, promoting the children involvement: the characters talk to the children and interact with them asking to do things, and commenting on the outcomes.

Each character of the video asks for children's help, or challenges them to do something. Each activity is focused on a creative operation (Widening-Connecting-Reorganizing), which the children have to apply to an environmental problem.

Metacognition was constantly used to stress the link of the playful aspects of the narrative training to everyday life, promoting a deeper understanding and awareness of the mental processes underlying creative thinking and eco-friendly attitudes.

PARTICIPANTS

The research project involved 76 children (mean age 7.5 years) attending Second Grade of two Primary Schools of Segrate, near Milan. Out of 4 classes, two were assigned to the control group (32 children) and were involved only in the pre and post-test evaluation. Other two classes were assigned to the experimental group (44 students). Each experimental class attended to the entire training, which was divided into five sessions. All the children had a similar socio-economical level: middle-class, with working parents.

The two schools were located on a similar suburban ground. Schools' policy was to be attentive to sustainability, so children assigned both to the experimental and control group were already aware of some basic issues related to sustainable behaviors.

Procedure and analyses

This research project, supported by a Partnership between the Department of Psychology of Catholic University of the Sacred Heart of Milan and the Milan Children's Museum (MUBA), took place during the months of April and May 2012.

It is possible to split the research project into three steps:

1. Assessment (pre-test, T1):
 - a. Children were asked to fill in the Subtest of Parallel Lines of Torrance and the self-report questionnaires aimed at assessing ecological attitudes. This first step took 45 minutes and was common to experimental and control group.
 - b. After the assessment, children assigned to the experimental group were shown the first video narrative – where they were given the first assignment – to be completed using the LIM before the first training session.
2. Empowerment (T2): it was divided into three sessions of 2 hours. During the training session, children watched the video-narration on the LIM. Every video was linked to a specific activity. Experts from the MUBA supervised two activities; researches from the Psychology Department supervised the others. Metacognitive monitoring and control were specifically enforced at the end of each session.
3. Assessment (post-test, T3): all the children (experimental and control) filled in the same questionnaires presented at T1. T3 happened a month after T1.

Quantitative data derived from the pre and post-test were analyzed using IBM SPSS statistics. We performed a paired sample t-tests to assess significant differences in the mean scores of experimental and control groups.

Students' responses to the training activities have been analysed with a qualitative approach (text analysis) in order to be able to monitor their motivational level.

Results

Environmentally sustainable attitudes

To verify the first hypothesis, we compared the pre and post-test scores of children assigned to experimental and to control group regarding their eco-friendly attitudes.

Table 1. T-test with Mean scores – first questionnaire, experimental group.

Item	Mean (DS) Pre-test	Mean (DS) Post-test	t ₄₃	p
1a. Mattia leaves the light on in the bedroom	1.36 (0.65)	1.02 (0.15)	3.51	< .001
1b. Mattia turns off the light in the bedroom, he will turn it back on later	4.55 (0.97)	4.86 (0.35)	-2.00	< .05
3a. Sara and Mattia prefer to go to school by car	1.98 (1.09)	1.30 (0.73)	4.13	< .001
5a. Sara chooses a notebook made of recycled paper	3.89 (1.41)	4.66 (0.98)	-3.58	< .001
5b. Sara chooses a normal notebook.	3.00 (1.50)	1.84 (1.16)	5.00	< .001
6a. Mum buys pre-packaged products as a snack for the children	2.32 (1.18)	1.39 (0.65)	4.75	< .001
6b. Mum buys organic products as a snack for the children	4.55 (1.02)	4.86 (0.40)	-2.01	< .05
8a. Sara and Mattia take the elevator	2.66 (1.12)	1.45 (0.59)	6.81	< .001
8b. Sara and Mattia use the stairs	4.30 (0.98)	4.73 (0.45)	-2.74	< .01
9a. Mattia takes a bath	2.00 (1.29)	1.45 (0.87)	2.23	< .05

As a first step, we run a paired-sample t-test on the 22 items of the first self-report questionnaire. Data reported in Table 1 show how, for the experimental group, there was a significant change in the desired direction for 10 items. The children gained a greater awareness on the issues of energy conservation, pollution and recycling. The control group did not show any improvement.

With regard to the data obtained from the second questionnaire, we performed a paired-sample T-test, which failed to detect any statistically significant change in the control group. Conversely, in the experimental group, significant changes in the desired direction emerged (Table 2).

Table 2. T-test with Mean scores – second questionnaire, experimental group.

	Mean (DS) Pre -test	Mean (DS) Post -test	t₄₃	P
Right answers	3.82 (2.00)	6.52 (1.75)	-7.95	< .001
Wrong answers	4.34 (2.26)	2.25 (1.75)	5.80	< .001
Missing answers	0.89 (1.66)	0.18 (0.54)	2.64	< .05

Considering the data relating to the third tool, we performed a paired sample T-test. The test did not show any significant change in the control group. On the contrary, significant changes in the desired direction emerged in the experimental group (Table 3).

Table 3. T-test with Mean scores – third questionnaire, experimental group.

	Mean (DS) Pre -test	Mean (DS) Post -test	t₄₃	P
Correct answers	19.95 (3.09)	22.00 (1.35)	-4.65	< .001
Wrong answers	4.07 (3.20)	2.00 (1.75)	5.80	< .001

Creativity

To assess the effect of the training on creative thinking, we performed a paired-samples T-test for each of the factors measured through the Subtest of Parallel Lines of Torrance (Table 4). Considering the three factors fluidity, flexibility and originality, a significant improvement in

the experimental group emerged. However, the control group improved as well, albeit to a lesser extent. Regarding the elaboration factor – only the experimental group showed a significant improvement.

Table 4. T-test with Mean scores – creativity test.

		Mean	SD	t (df)	p
Fluidity					
Experimental group	Pre-Test	7.02	3.35	-10.26 (43)	< .001
	Post-Test	13.48	5.13		
Control group	Pre-Test	9.59	3.97	- 3.07 (31)	< .05
	Post-Test	11.56	5.49		
Flexibility					
Experimental group	Pre-Test	5.16	2.68	- 9.28 (43)	< .001
	Post-Test	9.73	3.31		
Control group	Pre-Test	7.03	2.75	- 2.69 (31)	< .05
	Post-Test	8.44	3.60		
Originality					
Experimental group	Pre-Test	13.39	7.75	- 9.07 (43)	< .001
	Post-Test	25.95	10.12		
Control group	Pre-Test	15.41	7.56	- 2.20 (31)	< .05
	Post-Test	18.53	9.83		
Elaboration					
Experimental group	Pre-Test	12.20	7.02	- 11.15 (43)	< .001
	Post-Test	24.27	10.41		
Control group	Pre-Test	12.09	6.24	1.63 (31)	n.s.
	Post-Test	11.19	5.97		

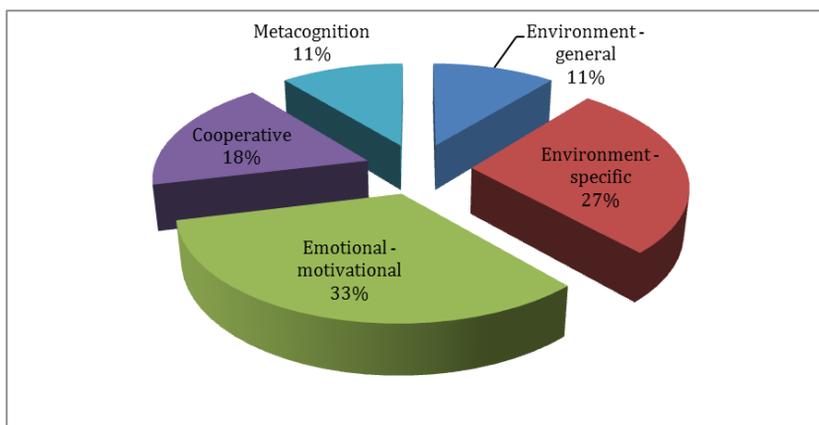
Motivation

We were also interested in assessing the efficacy of using a multimedia interactive narration (presented using the LIM) to promote not only effective learning, but also greater motivation and a more positive emotional response to the different activities.

To explore children's emotional response we carried out a qualitative analysis on the spontaneous written narration they provided at the end of the training – describing their experience.

We analyzed their writing counting the occurrences of statements referring to general environmental issues (e.g. I have learned the importance of keeping the word clean), specific environmental-friendly attitudes (e.g. I have learned that it's better to walk than using the car), positive emotional/motivational states (e.g. Watching the videos and working with Greeny was so much fun), cooperation (e.g. we did a great job because we worked together at the space ship) and metacognition (use of mental verbs). Results are reported in Figure 1.

Figure 1. Qualitative analysis of children spontaneous narrations.



The positive emotions elicited by the training clearly emerged by children's narration – as well as the acquired knowledge about specific environment-friendly attitudes. Children also showed a clear awareness of the importance of cooperation, and were able to use metacognitive strategies to reflect on their learning experience.

Discussions and Conclusion

The results show clearly that the research hypotheses were met: a creativity-based training promoting awareness and acquisition of

knowledge and skills necessary for the improvement of environmental conditions, built following the main goal attributed to environmental education programs by UNESCO (1978), is effective.

The first research hypothesis was confirmed: the training was effective in developing positive attitudes towards the environment. To be more specific, focusing on the first questionnaire, we found a significant improvement in those items referring to issues that were particularly stressed in the training, and this was true only for the experimental group.

In particular, data highlight how the process of empowerment has promoted a greater awareness regarding the issues of conservation of light pollution caused by cars, the possibility of using recycled paper, the origin of pre-packaged versus organic products, the importance of walking and saving water and energy.

Considering the two other tools, one focused on the correct way of recycling, and the second one assessing the knowledge of eco-friendly versus neutral or negative behaviors – we found significant improvement only for the experimental group. The fact that students significantly changed their attitudes/beliefs concerning the specific topics addressed by the creative activities proposed during the training stresses the relevance of a creativity-based intervention and confirms, for our specific sample, the link between attitude and creativity already reported in literature (McGuire, 1999; Schempp, Cheffers, & Zaichkowsky, 1983).

Moreover, the questionnaires used for assessing children's behavior used a similar format to the one used by the training (narrative and visual), possibly improved the efficacy of the assessment. It is also interesting to highlight how not only the children increased the number of correct answers between the pre-test and the post test, but also decreased the number of missing answers – showing a greater self-confidence and motivation, possibly promoted by the audio-video interactive format of the training – presented using the LIM – as we will discuss later. These results confirm some of the assumptions that emerged from literature. The importance of working on specific psychological determinants, first of all attitudes, has been confirmed. Moreover, the efficacy of the training proved that promoting the acquisition of flexible knowledge can foster a culture of sustainability, confirming the view taken by Lo Bello (2009).

The second research hypothesis was confirmed as well. The training promotes children's creativity. Results show that participants assigned to the experimental group gained a significant improvement in each of the 4 creativity factors assessed. This is coherent with the structure of the training that followed suggestions derived from literature, acting on the key skills linked to creative thinking (Antonietti, Colombo & Pizzingrilli, 2011), and assigning a key role to metacognition, through which it is possible not only to promote the acquisition of skills, but also to support greater awareness and control (Flavell, 1981).

It was interesting to note an unexpected improvement of the control group in the creativity test. Even if it was less strong than the one noticed in the experimental group, it was significant. This finding was interpreted as an effect due to the familiarity gained by children in filling in the test, increased by the creative work done in everyday classroom activity.

Results derived from quantitative analysis go in the desired direction and are very positive. It was also relevant, however, to analyze, from a qualitative standpoint, children's personal experience. Content derived from children's spontaneous narration highlights how they were involved in the plot and have acquired specific knowledge on ecological issues.

This stresses the relevance of using a narrative format to give meaning to the events, linking them to everyday experiences, which facilitate the learning process. The third hypothesis of our work is thus confirmed – though in a more transversal way. The opportunity of being part of the narration, presented in an interactive multimedia format through the LIM, promotes greater involvement and supports children's motivation, increasing the understanding of the correct attitudes and behavior and promoting environmentally responsible behaviors (Lee, 2011; Ruchter, 2010).

Despite the considerable strengths, the project has some critical aspects. The first application of training has allowed to point out that the timing was not adequate, as some activities required more time than expected. In addition, the fact that not all the ecological aspects considered were improved in the post-test, highlighted the need to add more highly structured activities, giving equal weight to the major ecological issues. The video narration itself appeared to be too long for the children, and not always clear.

Starting from the careful analysis of these issues, the project was revised up to a second version. The training was organized around four meetings of two hours each. Activities have been organized in a more balanced way, considering all the different environmental problems. Finally, we designed a more coherent narrative structure. This second version also gives more space to the interaction between the children and the narration: the use of the LIM has been enriched by the creation of blogs that allow children from different classroom to work cooperatively together.

Yet, the research allowed recording positive outcomes, stressing out the positive educational role that creativity and new technologies could have together. Trainings with such characteristics appear also to promote metacognition, motivation and cooperation among children. Teacher should consider using more these strategies to change children's attitudes and change their behavior when they aim at promoting more adequate eco-friendly behaviors. Future research should also explore this positive correlation building and applying similar training to change children's attitudes towards different socio-cognitive topics.

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