

Urban Metabolism and Minority Pulse Campaign (UMMP): An educational approach to help children make informed decisions on sustainability issues

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Abstract

Investing in our children is investing in our future. Children are the basis for all dimensions of sustainable development. There is a need for children to be at the forefront of the UN Sustainable Development Goals (SDGs) Agenda. Now more than ever, children are considered one of the most vulnerable populations affected, whether it's dealing with poverty (SDG1), hunger (SDG2), health, and well-being, (SDG3), quality education (SDG4), gender equality (SDG5), climate action (SDG13), and violence against children (SDG16.2) (UN 2020). Scientific evidence has shown that early childhood is a critical stage of human development, laying down the foundations of brain architecture and functioning (UNICEF 2020). This study aims to understand the role of SDG education in children using a variety of tailored best practices (audio, visual, psychological, and cognitive) to help develop informed opinions and envision possible answers to sustainability pathways. Our study included a total number of Italian children participants and exposed to real-life scenarios on: pollution, factory emissions, and consumption behaviors. Our study applied the Urban Metabolism and Minority Pulse (UMMP) Campaign methods and guidelines for children (including games, recycling activities, story-telling, and painting) in the city of Mantova, Italy. The study includes a number of test phases: (i) Pre-treatment, (ii) test-treatment, (iii) Post-treatment (Fernandez and Maione 2020). The Pre-treatment test stage participants were given a set of activities to: (i) *draw their own pathway 'from home to school'*. The Post-treatment test allowed participants to: (ii) *draw their ideal pathway 'from home to school', with regards to the environmental effects, sustainability considerations, the SDGs framework, and pro-environmental practices*. The same approach was used to educate children to identify problems and possible solutions in relation to the implementation of the 17 SDGs. During the Pre-treatment testing, participants were asked to: (i) *draw the current stage of the SDGs achievement around the world*. While in the Post-treatment testing phase participants were encouraged to: (ii) *draw how they envision the SDGs achievement by 2030*.

Results demonstrated a positive outcome on the perception of children when implementing and testing the UMMP design approach, while being introduced to the risks of human health, poor air quality, including smog and emissions from cars, and real life cases from cities with exceptional emissions. All participants demonstrated critical changes in positive behavioral and perception patterns. For instance, before the treatment, only 20% of participants reported sustainable mobility behavior (i.e. walking or biking to school), while the majority of the participants relied on private transportation means. After the treatment, 46% of participants acknowledged that they lived within a walking distance from their school (1 km or less) and could walk in safe conditions (presence of a pedestrian lane, good maintenance of infrastructure, functioning lights, or traffic separators). Out of the remaining 54%, a total of 53% declared to have easy access to cycling infrastructure and individual bikes, and 1% of the participants came up with creative transport solutions, such as horseback riding or using roller skates to travel to and from school.

Keywords: Children; SDGs; Education; Informed decisions; Sustainability

1. Introduction

1.1. UMMP campaign overview

In recent years, the analytical outlook of urban metabolism and resource efficiency studies has pulled back from a one-size-fits-all to more inclusive civic awareness programs. The exponential increase in discussion on sustainability-oriented civic awareness has been amongst the most novel and transformative features in advocating for climate change adaptation over the past years. Studies have focused on the urgency to reduce the environmental impact of anthropogenic activities in order to remain within a safe operating and balance space for humanity by setting the most appropriate pathways for urban resource consumption mitigation (Zhang 2013). In this perspective, city governments are shifting towards more sustainable development strategies to combat environmental anthropogenic hazards.

Within this framework, we applied the lens of “urban metabolism” by viewing the city as a living organism to our study to develop educational tailored sustainable development contents and activities for minority groups. Amongst the benefits, urban metabolism studies can be applied as a holistic design approach used to promote resource awareness, research, and inclusive education. Develop environmental policy recommendations, and sustainable design approaches for city development while preserving locally available urban resources (e.g., Fernandez 2018, p.265; Maione 2016, p.106-107). Urban metabolism entails the study of all flows entering an urban system in the form of material and immaterial resources, and exiting urban systems in the form of waste and pollution (Ferraio and Fernandez 2013, p.166). Therefore, the study of the metabolic balance of cities identifies the nexus between environmental degradation on the one hand, and socio-economic behaviors of citizens on the other. An urban metabolism-based approach can help address the major barriers to sustainable development, such as the lack of inclusion and integrity, as well as foster co-design and solutions, and sustainable strategies. Hence, to provide a better understanding of the more complex interconnections between an urban area, its socio-economic dynamics, environmental, and ecological impacts, quality of life and well-being of its human and non-human communities (Fernandez 2018, p.268). Global issues such as climate change urgently require a shift in our lifestyles, behaviors, and a transformation of the way we think and act. To achieve this policy change in cities, decision makers need to acquire new skills, adapt to cultural values, and positive attitudes towards all populations including those of under representative communities that lead to more sustainable, equitable, and inclusive societies.

By transforming sustainability-oriented minority education and combining it with the SDGs awareness and urban metabolism studies, the learning challenge becomes more ambitious and requires a thorough investigation of the learning environment. In light of these considerations, in 2017, we launched a pioneering study aimed at educating a wide range of minority groups on the environmental challenges of the XXI century, including climate change, and resource efficiency (Fernandez and Maione 2018; Fernandez and Maione 2019; Fernandez and Maione 2020). In order to advocate towards a more equitable and inclusive education on sustainable development. As part of an awareness campaign titled “Urban Metabolism and Minority Pulse (UMMP): An Education and Awareness Campaign Targeting Minority Groups,” the study was developed in three phases. (i) During Phase I, from April to May, 2017, we develop a campus-wide awareness initiative at the Politecnico di Milano, Milan (Italy) to advocate for the creation of an interdepartmental network of students, researchers, staff, and professionals on sustainability issues in cities and the SDGs. (ii) In 2017, between the months of May and July, we implemented Phase II that entailed a number of community-based workshops, seminars, training courses, and educational program activities in the cities of Milan and Mantova, in northern Italy.

This study focuses on analyzing the socioeconomic and demographic indicator characteristics of selected target groups such as age, gender, learning capacity, and social status as a selection criteria. (iii) Based on Phase II findings we developed tailored method guidelines and

policy toolkits to develop synergies between citizens, public, and private entities, and minorities using strategy design (Fernandez and Maione 2018). While Phase I and Phase III fall outside the scope of this paper, it is our aim to advance a better understanding of minority needs in the field of education and environmental challenges for all. This paper provides a replicable learning methodology for Learners (Educators) to employ a number of SDG-based activities and a Step-by-step guide to interpret learning outcomes when working with minority education.

1.2. UMMP Campaign: Phase II

The UMMP campaign entails three phases, of which Phase II is within the scope of the present study, with the overarching goal of providing minority education. Figure 1, shows the study's selected under-representative target groups with characteristics of children, elderly, people with disabilities, homeless and refugees, students and academics, LGBTI+ community, and women. Phase II took place between the months of May and July, 2017 and aimed at implementing community-based, tailor-made workshops, seminars, training courses, and educational programs targeting the seven groups. Target groups were selected based on the Author's own interpretation and considered a non-exhaustive list. The research activities took place in the cities of Milan and Mantova, in northern Italy, representative of large-and medium-size cities.

Phase II of the UMMP campaign was oriented to provide learning methods such as: (i) minority tailor-made learning recommendations for Learners using cognitive, linguistic, sensorial, spatial, physical, methods to help cities localize the SDGs; (ii) cognitive knowledge and thinking skills necessary to better understand sustainable development policies and challenges to achieve them; (iii) the development of social skill requirements that enable Learners to collaborate, negotiate, and communicate to promote the SDGs, as well as self-reflection skills, values, attitudes, and motivations that enable Learners to develop on within their own Agenda; and (iv) provide education guidelines on responsible consumption and pro-environmental behaviors that can lead action towards greater resource efficient behaviors.

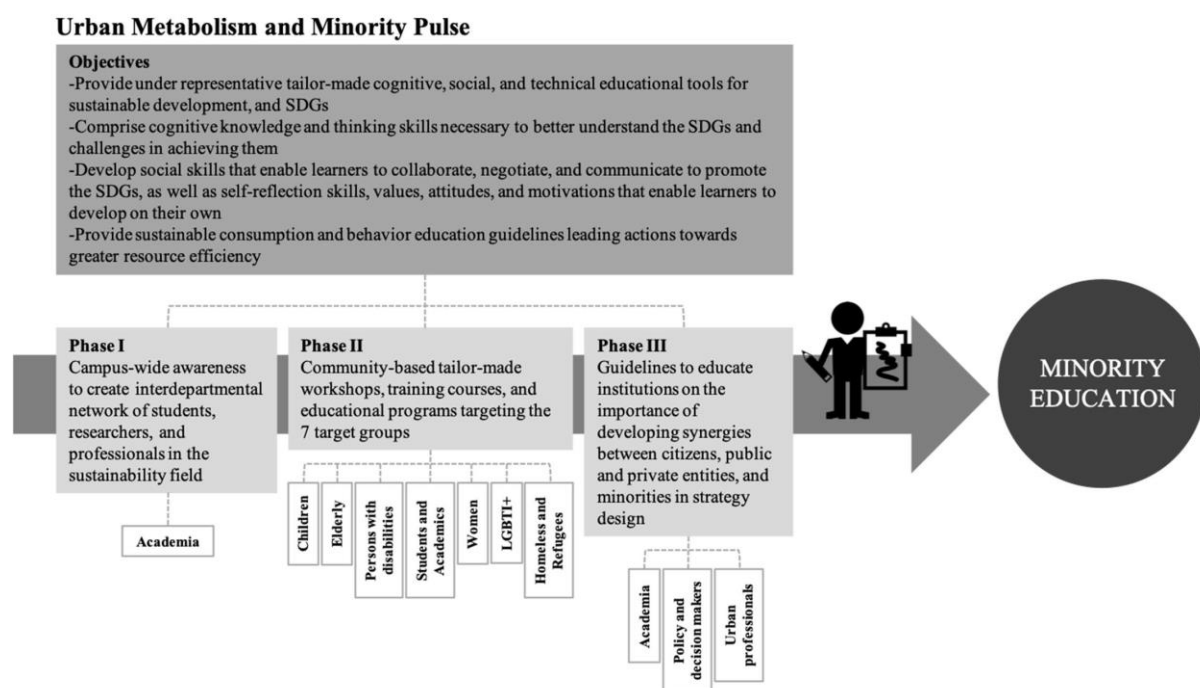


Figure 1. UMMP methodology overview and phases (Fernandez and Maione 2020).

2. Background

2.1. UMMP Campaign manifesto

The UMMP campaign platform features a replicable toolkit and methodology structured to facilitate awareness on resource management, community engagement, city planning, and environmental design. Targeting the unheard minority voices of society to provide knowledge exchange between municipal governments, educational institutions, and community based organizations. Our goal is to create a cross city analysis to identify best practices globally that empower all citizens coming from different paths of life to create more sustainable changes in the urban environment.

Figure 2 shows the UMMP campaign target groups, based on age, gender, city, and country of province, from academia, public and private professionals, children and citizens in the city of Milan and Mantova, Italy. The campaign aimed to map and assess the participants' knowledge of urban metabolism and material flow concerns in cities, sustainable initiatives currently taking place in their hometown, and methods and solutions used to manage urban resource inefficiencies.

Urban Metabolism & Minority Pulse Campaign

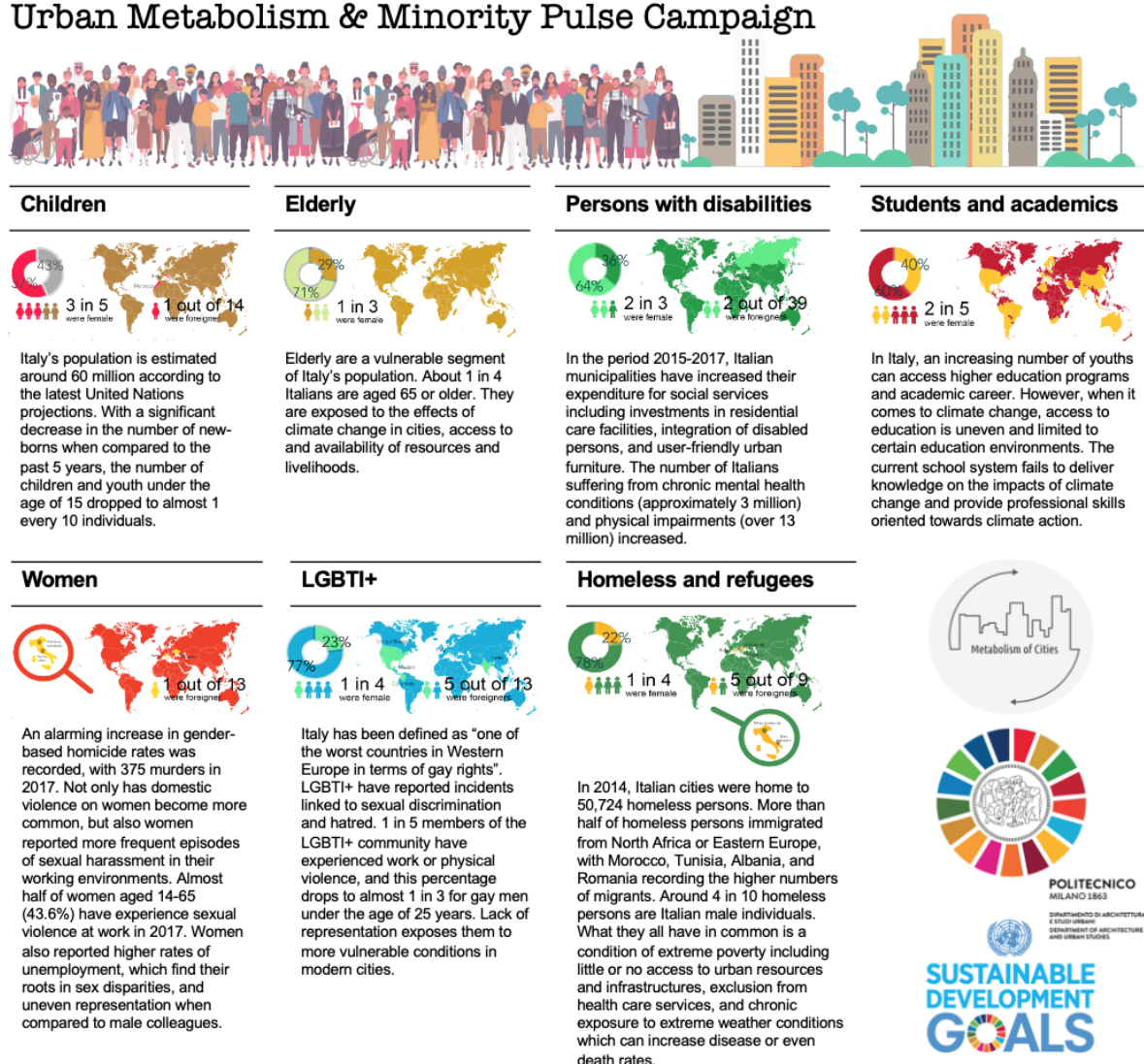


Figure 2. Urban Metabolism and Minority Pulse Campaign overview

(Blog: <https://archive.metabolismofcities.org/blog/11-urban-metabolism-and-minority-pulse-an-urban-metabolism-education-and-awareness-campaign-targeting-minority-groups-2017>
Video: <https://youtu.be/tKSollzsew>)

2.2. Selection of minority target groups

The campaign includes seven minority groups identified in Phase II. In our study, we analyzed age, gender, learning capacity, and social status as a selection criteria. Understanding cognitive ability was also considered a discriminant factor to design tailored learning methodologies. Based on criteria, the study sample composition included a total number of 163 participants across seven different groups using purposive sampling: children (N=14), elderly (N=14), persons with disabilities (N=39), students and academics (N=55), women (N=13), LGBTI+ youth (N=13), and homeless and refugees (N=15).

The study's sampling was made possible through a collaboration with several local-based academic institutions, NGOs, and local organizations (i) academia: Istituto Comprensivo di Porto Mantovano (Mantova, Italy), (ii) center for persons with mental and physical disabilities: Anffas Onlus (Mantova, Italy), (iii) center for elderly: Centro Sociale Anziani Soave (Mantova, Italy), (iv) NPOs: Metabolism of Cities (Brussels, Belgium), (v) universities: Politecnico di Milano (Milan, Italy), and (vi) student association: Poliedro (Milan, Italy).

2.3. Glossary of key terms

The following subsection presents a non-exhausted list of taxonomy words recommended for Learners on sustainable development education. The keywords were used by authors during campaign activities.

Table 1. Learners UMMP campaign - SDGs educational glossary and checklist (1: Children; 2: Elderly; 3: Persons with disabilities; 4: Students and academics; 5: Women; 6: LGBTI+; 7: Homeless and refugees).

Keyword(s)	Characteristics	Target(s)						
		1	2	3	4	5	6	7
Climate change	Describes the changes in global or regional climate patterns over time, with implications of local weather conditions.	x	x	x	x	x	x	x
Pro-environmental behavior	A number of practices and actions driven by care for the environment and sustainable consumption, such as anti-littering practices, reduced consumption of non-renewable goods, and more efficient resource use.	x	x	x	x	x	x	x
Recycling	Defined as the process of collecting and processing materials that would otherwise be thrown away as trash. Recycling is aimed at turning waste materials into new products with similar applications.	x		x	x	x		
Reducing	Waste reduction encompasses a number of measures taken before purchasing a product (e.g., choices on materials and packaging), during the usage phase, and after use (e.g., disposal options) aimed at minimizing waste production.	x	x	x	x	x	x	x
Resource efficiency	Defined as sustainable sourcing and use of Earth's resources, with regards to non-renewable resources, to minimize waste and environmental impacts.	x	x	x	x	x	x	x

Reusing	Reusing is a form of waste prevention as it temporarily prevents materials from entering the waste phase. Hence, it is considered a postponement strategy.	x		x	x	x		
Sustainable Development Goals (SDGs) (Figure 3)	The SDGs are 17 sustainability-oriented goals and related targets and offer a guiding framework to achieve sustainable development leveraging its three dimensions: social, environmental and economics. They address a number of global challenges and offer a tool to map, localize and track progress on their achievement.	x	x	x	x	x	x	x
Sustainable mobility	Defined as a mind shift car-centered society to an interconnected system of public transport, bicycle and pedestrian paths oriented to reducing the carbon emissions associated with transportation.	x			x	x		
Urban metabolism	Concept refers to the totality of material and energy flows throughout an urban system. It encompasses material and energy throughput, emissions, waste and pollution.	x	x	x	x	x	x	x
Waste	Definition of “waste” can vary based on type, origin, and application sector and disposal options. In general, it is identified as waste a material that is no longer used and needs to be disposed of. Based on its disposal, waste can become “trash” when it is dumped or a “resource” when it is re-introduced into the value chain to be transformed into a new material.	x	x	x	x	x		
Zero waste	Defined as the conservation of all resources through responsible production, consumption, reuse and recovery of products to reduce the environmental impacts associated with dumping and incineration. A zero-waste society is based on the elimination of incinerators and landfills by shifting from a “throw-away” society to a sustainable one.	x	x	x	x	x		



Figure 3. UN Sustainable Development Goals

2.3. A focus on children

Based on the seven under representative groups conducted with the UMMP campaign the study focused on one specific target: Children. Today, children are considered among our most vulnerable, fragile, and innocent targets. The number of children dying before the age of 5 reached the new low of 5.6 million in 2016, with an increase of 41% to 46% compared to 2000. According to researchers it is important to develop skill integration reproduction in primary and secondary schools towards an informed and environmentally cautious society to

foster a skilled generation of youth free from environmental dangers and social injustices (Hug et al. 2017).

3. Materials and methods

3.1. Selection of the study's participants

The children workshop, titled “Urban Metabolism and Minority Pulse: Children Campaign”, was conducted through the collaboration with the Istituto Comprensivo di Porto Mantovano (Comprehensive Institute of Porto Mantovano) located in the city of Mantova, Italy. Participants in the workshops included 14 children aged 3-4, of which 57% were female and 43% were male.

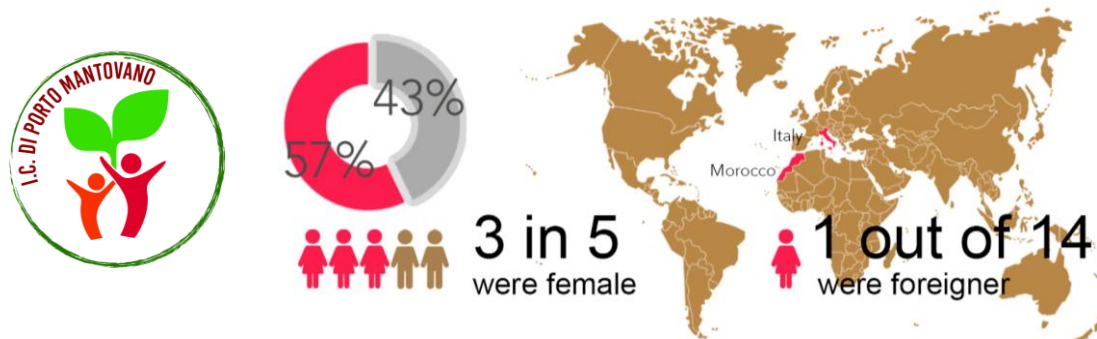


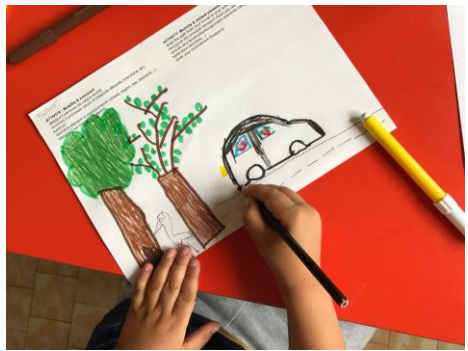







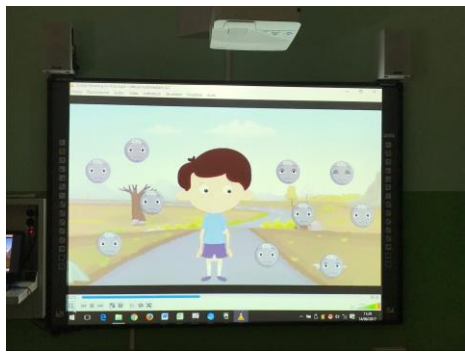








Figure 4: Descriptive statistics of children participants in the UMMP campaign.

3.2. Workshop activities for Learners

The children workshop activities aimed at furthering an understanding of the taxonomy of words presented in Section 2.2. To this end, children were exposed to everyday implications of mobility, waste management, resource consumption, and climate change, as shown in Table 2.

Table 2. Learner activities on children related to the SDGs

Activities	Word Taxonomy	SDGs	Photos
Journey paths from home to school & exploring sustainable modes of transportation.	Sustainable mobility, Pro-environmental behavior, Climate change, SDGs	 	

Material consumption categorization awareness by color, shape and symbols & the understanding of item conditions.	Recycling, Reducing, Reusing, Resource efficiency, Waste, Zero waste, Pro-environmental behavior, SDGs	 	
Visuals on air pollution worldwide.	Sustainable mobility, SDGs, Climate change	 	
Creation of polar bear face masks using household recyclable material items.	Climate change, SDGs	 	
Exploring real life problems using art: SDGs before and after scenario activity	SDGs		
Analyzing Earth's elements through the use of art: comic book superhero flow squad named 'Urban Metabolism and Minority Pulse Squad.'	Urban metabolism, Resource efficiency, Waste, Zero waste, Pro-environmental behavior, SDGs	 	

The workshop is composed of three phase activities: Phase I, (Pre-treatment), children were tested on specific issues concerning their daily lives. Phase II, (Treatment), was centered on providing a deeper understanding of the environmental challenges presented by children, through a visualization presentation of case studies (photography, charts, animation) from around the world. Presentations encompassed different learning tools, such as storytelling, video, and photo material, audio, and board games. Finally, Phase III (Post-treatment) allowed

children to understand how events shifted from a less sustainable view to more sustainable, leveraging what they learnt during treatment (before and after scenarios). Hereinafter, two workshop activities are presented: Mobility Awareness Activity and SDGs Awareness Activity. For what concerns the first activity, children were asked to draw their *route from home to school*. They were then exposed to stories of mobility-related pollution and emissions, including videos and audio on how CO₂ and other emissions originate and are released into the atmosphere. In addition, photos of children wearing masks to protect from smog, and images of how a city can change under extreme pollution conditions were shown. After the treatment, the workshop's participants were asked to draw *their ideal pathway 'from home to school'*, including considerations on the environmental effects, sustainable mobility and pro-environmental practices, based on their own takeaways.

The second activity was organized as follows: First, children were asked to draw *the current stage of the SDGs achievements from around the world*, with reference to their hometown or places where they have travelled. For this activity, they were presented with a list of all the SDG icons and a brief description with photos of the issues that each SDG addressed. During the treatment, children actively participated in gaming activities to foster thinking, creativity and problem solving skills towards the achievement of the SDGs by 2030. They were successively asked to draw *how they envision the SDGs achievements by 2030*. It is important to note that these assignments were not aimed at providing real-world solutions, rather to assess the ability of children's thinking to develop informed opinions and actively provide solutions to everyday challenges. Table 3 shows the mobility awareness and SDGs activities.

Table 3: Mobility Awareness Activity and SDGs Awareness Activity presentation.

Activity	Pre-treatment	Treatment	Post-treatment
<i>Mobility Awareness Activity</i>	Route from Home to School	Storytelling, videos, photos and audio	My commitment to the SDGs (Footprint Activity)
<i>SDGs Awareness Activity</i>	Current situation for each SDG	Storytelling and board games (memory game)	Ideal situation: how do you envision this by 2030?

3.3. Urban metabolism pillars

Figure 5 highlight the key action activities employed in this study for the under representative targets categorized in six pillars as a form to rethink the urban metabolism: 1) Awareness, education, and research; 2) New infrastructure and system thinking: Data; 3) Recovery, reuse and recycling; 4) Sustainable consumption and behavior; 5) Transformed industrial design; and 6) Depletion legislation and policies (Fernandez 2018).

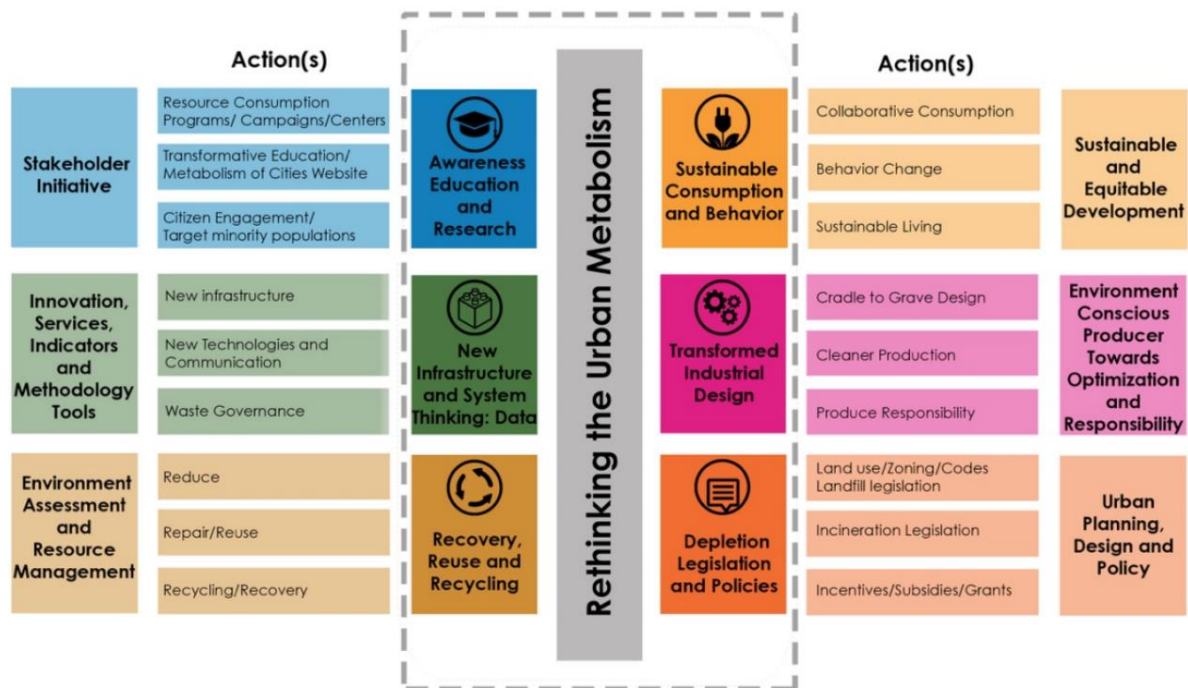


Figure 5. Key characteristics of the urban metabolism pillars (Fernandez 2018).

4. Results and analysis

4.1. The role of education in SDGs agendas

Education is both a goal in itself and a means for attaining the SDGs. It is not only an integral part of sustainable development, but also a key enabler for it. That is why education represents an essential strategy in the pursuit of the SDGs. However, in order for the SDGs to be implemented successfully city professionals and Learners need to work closely with different groups of people. The Step-by-step Learner's guide is designed to guide professionals on effective teaching of the SDGs to different groups. As a result, education systems must respond to this pressing need by defining relevant learning objectives and learning contents that empower Learners, and urging their institutions to include sustainability principles in their management structures. The guide does not aim to be prescriptive in any way, but to provide guidance and suggestions that Learners can select and adapt to fit concrete learning contexts.

The specific learning activities are to be seen in conjunction with the cross cutting sustainability's competencies. This knowledge could be acquired by conducting case studies on children relating to these goals in selected cities. At the same time, this learning activity contributes to a person's system thinking competency by facilitating the perception that multiple factors influence children. But systems thinking competency is not limited to systems thinking concerning children. As a key competency, it enables the Learner to understand the complex interrelations in the fields of other SDGs as well. Moreover, it is vital to set specific learning objectives and activities for the different SDGs. But we must also remember that these activities must not be viewed as isolated from the sustainability key competencies that will support us in our transition to a sustainable world. Learning objectives and key competencies must be pursued together. The learning activities and SDGs shown outlined in this document are therefore informed by best practice for developing competencies on minorities.

4.2. Learning outcomes

Learning outcomes are hereby presented based on the six urban metabolism pillars used for this approach (Table 4). For what concerns the first pillar, *Awareness, education, and research*, we observed that the learners understood the main drivers of sustainable development, by integrating storytelling, linguistic exercises, visual and spatial learning, and

audio activities. In addition, to raise awareness of the importance of equal education for all, we used a holistic approach to education on sustainable development and related projects through outreach programs tackling multiple languages and designs and developing ways to promote free and equitable education for all.

Second, with regard to *New infrastructure and system thinking data*, the learners explored the use of technologies, while considering targets with a lower understanding of technology education (e.g., children with disabilities, ADHA, children with inattentive disorders, etc.). The approach consisted of the use of virtual reality devices, sensorial and hybrid experience, integrated technology, systems thinking, and strategic thinking to measure their surroundings. The learner could differentiate between an array of technologies to meet their needs.



























































Third, in relation to *Recovery, reuse, and recycling*, the learners worked with peers to develop self-assessment of their learning capacity. Through this assessment, each learner was able to understand their takeaways in relation to the 3Rs as defined within the pillar's context, and present their results to the class.

Fourth, in the context of *Sustainable consumption and behavior*, we assessed the learner ability to change their household and personal consumption behaviors through cross-curricular teaching. The learner learnt the basic principles of pro-environmental behavior at home and suggested a list of key activities to implement their current behavior.

Five, with regard to *Transformed Industrial design*, the learners compared and assessed different child-friendly business models and their impacts on the environment. The learners developed visions of reliable, sustainable problems, and solving skills. For this activity, goals were set based on scenarios that were familiar to the learners.

Finally, during the *Depletion legislation and policies* activity, the learners understood how policies can influence the production, supply, demand, and usage of material/non-material through the use of cooperative learning structures. The learners were able to evaluate and compare the sustainability of their and other behaviors in meeting their needs particularly in the areas of food, energy, transport, resources, water safety, and waste.

Table 4. Alignment between pillars, learning approaches, and target groups (Adapted from Fernandez and Maione 2020).

Target groups	Actions								
	 Pillar 1. Awareness, Education and Research			 Pillar 2. New infrastructure and system thinking: data		 Pillar 3. Recovery, reuse and recycling	 Pillar 4. Sustainable consumption and behavior	 Pillar 5. Transformed industrial design	 Pillar 6. Depletion legislation and policies
	Linguistics/ Story-telling/ critical thinking	Visual and spatial learning	Audio	Sensorial & hybrid experience / strategic	Integrated technology / systems thinking	Assessment for learning / self awareness	Cross curriculum teaching	Goal setting/ problem solving/	Cooperative learning structures
Children									
Elderly									
Persons with disabilities									
Students and Academics									
Women									
LGBTI+									
Homeless and Refugees									

4.3. UMMP Campaign workshop outcomes on Children

Our results demonstrated a positive outcome on the perception of children of sustainability-related topics. After the treatment, all participants showed critical changes towards positive behaviors. During the Mobility Awareness Activity, before the treatment only 21% of participants reported sustainable mobility behaviors, of which 14% reported that they walk to school and 7% rode a bike to and from school. Results of the mobility assessment Pre-treatment are presented in Figure 6 and Figure 7.

Outputs

Children Mobility activity outcomes

ATTIVITA': Mobilità & emissioni

- disegna il percorso da casa a scuola
- riconosci il principale mezzo di trasporto utilizzato (macchina, bici, autobus)
- identifica elementi di riconoscimento (chiesa, negozi, bar, ristoranti,...)
- disegna il tuo impegno (footprint)

ACTIVITY: Mobility & related emissions

- draw the path from your house to your school
- recognize the principal transport mean you use (private car, bike, bus)
- include any landmarks/recognizable elements (religious building, shops, restoration activities,...)
- draw your commitment (footprint)



Figure 6. Children Mobility Activity outcomes



Figure 7. Results of the Mobility Awareness Activity before Treatment.

After the Treatment, 46% of participants acknowledged that they lived within a walking distance from their school (1 km or less) and could walk in safe conditions (presence of a pedestrian lane, good maintenance of infrastructure, functioning lights, or traffic separators). Out of the remaining 54%, a total of 53% declared to have easy access to cycling infrastructure and individual bikes, and 1% of participants came up with creative transport solutions, such as horseback riding or using roller skates to travel to and from school. The Post-treatment results are presented in Figure 8.

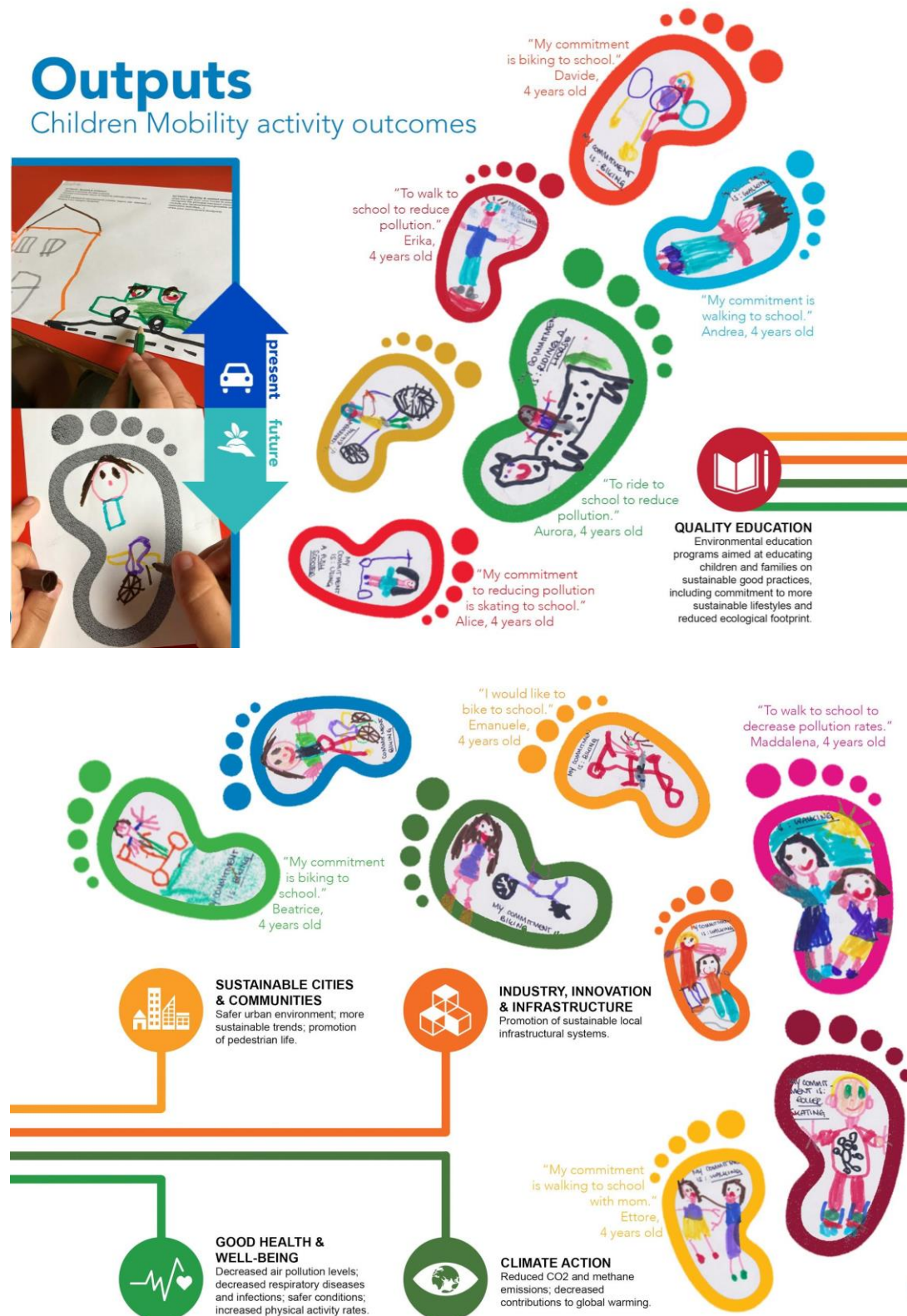

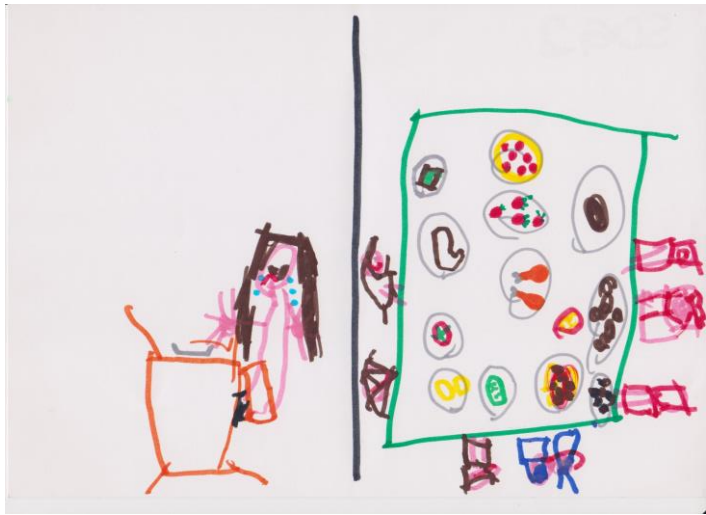








Figure 8. Results of the Mobility Awareness Activity after the treatment.




Similarly, all participants showed positive results during the SDGs Awareness Activity. Table 5 reports the results of the activity before and after the treatment, showing children's understanding of the current status of each SDG and some suggestions to accelerate their achievement by 2030.



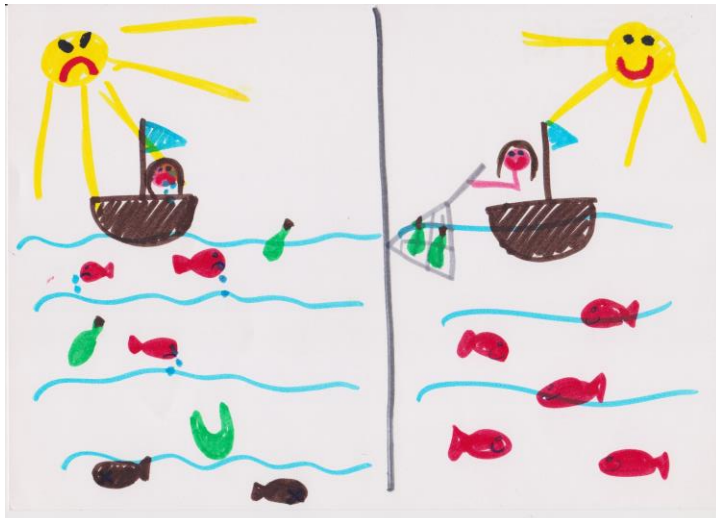
Table 5. SDGs Awareness Activity: Before (left) and after (right) d.

SDGs	Before / After Children SDGs Designs
1. No poverty	 <p data-bbox="571 873 1289 943">(Left: two sad children with old clothes; Right: many children with new clothes)</p>
2. Zero hunger	 <p data-bbox="571 1478 1279 1547">(Left: a child crying because there is no food; Right: many children sitting around a table filled with food)</p>

<p>3. Good health and well-being</p>	 <p>(Left: a sick child; Right: a child with a medical kit)</p>
<p>4. Quality education</p>	 <p>(Left: a child crying because school is closed; Right: a child smiling and showing books)</p>
<p>5. Gender equality</p>	 <p>(Left: a girl crying because boys make her feel little; Right: many girls smiling)</p>

<p>6. Clean water and sanitation</p>	 <p>(Left: a child under dirt rain water; Right: a child smiling to clean rain water)</p>
<p>7. Affordable and clean energy</p>	 <p>(Left: a child crying because there is pollution from industries; Right: a child happy because they live in a world with no pollution)</p>
<p>8. Decent work and economic growth</p>	 <p>(Left: a sad child crying because their parents have no money; Right: a smiling child living in a nice house)</p>

<p>9. Industry, innovation, and infrastructure</p>	 <p>(Left: a child crying because they live in an isolated village; Right: a child using local infrastructure)</p>
<p>10. Reduced inequalities</p>	 <p>(Left: a child lonely and abandoned; Right: a happy child that feels part of a community)</p>
<p>11. Sustainable cities and communities</p>	 <p>(Left: a sad child that lives in a city with no green spaces; Right: a happy child in a green sustainable city)</p>

<p>12. Responsible consumption and production</p>	 <p>(Left: sad children in park full of trash; Right: a child walking in a clean environment)</p>
<p>13. Climate action</p>	 <p>(Left: sad child and polar bear during ice melting; Right: happy child and polar bears in an icy world)</p>
<p>14. Life below water</p>	 <p>(Left: sad child and fish in a polluted sea; Right: a child collecting trash from the sea)</p>

15. Life on land



(Left: a sad panda during deforestation; Right: pandas eating bamboo and playing music)

16. Peace, justice and strong institutions



(Left: a sad child threatened by a ghost; Right: many children dancing together)

17. Partnerships



(Left: a sad and lonely child; Right: children playing)

After the Treatment, children were asked to make examples concerning how they experience each SDG in their own daily life. For example, when asked about SDG13, participants said:

“Il surriscaldamento globale è quando fa troppo caldo e il mio gatto soffre.”

[Global warming happens when it is so hot and my cat suffers because of that.]

“C’è il cambiamento climatico perché non piove più e il mio cane non può più bere nelle pozzanghere.”

[Climate change means decreasing rates of rainfall and my dog is unable to drink from puddles.]

5. Conclusions

This paper presented the UMMP campaign outcomes of a number of workshops developed with children. The workshops were aimed at understanding how children foster their creativity to envision sustainable solutions before and after a treatment. The treatment consisted of story-telling and sensorial activities centered on SDG-education. For all children participants, we noticed positive change in their behaviors before and after the treatment.

This study explores how inclusion of minority groups in education programs and awareness campaigns on urban metabolism and climate change can help policy makers to co-design solutions for sustainable development at the city level. The study can assist Learners in the creation of a pro-active learning environment where all groups are given equal consideration. Drawing on the SDGs, we developed an inclusive and easily accessible toolkit for Learners that serve as a common language to deliver knowledge on climate change, urban metabolism, and resource consumption. This research aims at providing a non-exhaustive set of workshop activities that can be scaled and replicated and a set of policy recommendations on innovative approaches to minority education. In particular, we contend that a focus on target minority groups will benefit society in its entirety by creating a direct dialogue between policy and decision makers, experts, urban metabolism scholars, and communities that are most affected by overconsumption of resources and extreme climate events. For the UN goals to be reached, everyone needs to do their part: governments, the private sector, civic society, and every human being across the world. Governments are expected to take ownership and establish national frameworks, policies, and measures for the implementation of the 2030 Agenda. Embarking on the path of sustainable development will require a profound transformation of how we think and act. Therefore, education is crucial for the achievement of sustainable development.

Learners have the opportunity to further explore a series of cognitive, socio-emotional, and behavioral learning at the micro and macro level. Future research may allow the Learner to work closely with minorities to evaluate, monitor, and identify further method behavior opportunities within their own SDG Agenda. Further research is needed to explore specific learning types in detail for all SDGs by implementing a number of real-life scenarios using technologies, gamification, nature based solutions, hybrid public, and private analysis, and tailor based method solutions. There is an importance in tailored education and training solutions, recognition of boundaries between target populations, provision of a flexible toolkit and simplified technologies. For Learners to practice data sharing, hybrid governance simulation systems, and using virtual reality technologies to capture everyday life through psychological analysis methods. The idea is to share the stories of minorities through their own eyes and encapsulate meaningful rhetorical findings.

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