# Scientific research and environmental education: the participatory approach of the MAPS-MI projects in schools of Milan, Italy

Ricerca scientifica ed educazione ambientale: l'approccio partecipativo dei progetti MAPS-MI nelle scuole di Milano

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## Abstract

The accumulated scientific evidence regarding the effects of air pollution on health calls for urgent and effective action to protect the most vulnerable part of the population, such as children and the elderly. In this context, the participatory approach represents a viable option to empower citizens and increase their level of awareness and participation. The involvement of civil society is a potential ally in tackling the still open research challenges.

The MAPS-MI 2018-2019 **Mapping air pollution in the catchment area of an elementary school of Milan** and MAPS-MI 2022-2023 **Mobility, environment and participation in the schools of Milan** projects are here presented.

The main targets of the projects are primary and middle school children, their parents and teachers, with some activities extended to the entire citizenship.

Starting from the survey on parents' habits and opinions about mobility and air pollution, to the air quality and personal exposure assessment, and the field-testing and development of an environmental education module, the MAPS-MI approach aims to increase knowledge and awareness about air pollution and to involve stakeholders in experimenting practices towards change.

The first results suggest that adopting a participatory approach in the fields of exposure science and environmental epidemiology is a winning choice in terms of quality research, participation and community impact.

**Keywords:** air pollution, children, environmental health, participatory science, sustainability

## Riassunto

Le evidenze scientifiche sugli effetti dell'inquinamento atmosferico sulla salute chiamano a urgenti e più incisivi interventi a tutela delle fasce di popolazione più vulnerabili, quali minori e anziani. L'approccio partecipativo rappresenta un valido strumento per dare maggiore potere ai cittadini e aumentare il loro livello di consapevolezza e partecipazione. Il maggiore coinvolgimento della società civile rappresenta un potenziale alleato nell'affrontare le sfide ancora aperte nei diversi ambiti di ricerca. In questo articolo vengono presentati i progetti MAPS-MI 2018-2019 **MAPpatura dell'inquinamento atmosferico nel bacino d'utenza di una scuola elementare e identificazione dei percorsi casa-scuola ideali** e MAPS-MI 2022-2023 **Mobilità, Ambiente e Partecipazione nelle Scuole di Milano**. Il target principale sono i bambini delle primarie e secondare di primo grado, i loro genitori e insegnanti, con alcune attività rivolte all'intera cittadinanza.

A partire dall'indagine sulle abitudini e le opinioni dei genitori in tema di mobilità ed inquinamento atmosferico, ai monitoraggi della qualità dell'aria, a quelli dell'esposizione personale, e allo sviluppo sul campo di un modulo di educazione ambientale, l'approccio MAPS-MI ha l'obiettivo di aumentare conoscenze e consapevolezza e di sperimentare pratiche di cambiamento. I primi risultati suggeriscono che l'adozione di un approccio di tipo partecipativo nell'ambito delle scienze dell'esposizione e dell'epidemiologia ambientale è una scelta vincente sia in termini di qualità dell'esperienza di ricerca sia di partecipazione e di potenziali ricadute sulla comunità.

**Parole chiave:** inquinamento dell'aria, minori, salute ambientale, scienza partecipativa, sostenibilità

## Context and objectives

Air pollution in urban areas is a well-known issue on the European Community's agenda.[1,2] When considering air pollution sources in urban areas, vehicular traffic is of high concern as it is responsible for a toxic mix of pollutants closely related to both combustion processes and non-exhaust emissions (brake wear, tyre wear, road wear, and resuspension of road dust).[3,4]

As regards the health effects, children are among the groups at higher risk.[5] A growing body of scientific literature connects the increase of exposure with a greater risk of cancer,[6] respiratory problems,[7] up to the most recent evidence regarding cognitive impairment and behavioural disorders.[8] Furthermore, emissions in urban areas play a primary role in the global alteration of ecosystems and climate processes that see Italy among the most exposed territories.[9] Future generations will have to face the consequences of global warming, while the youngest ones are already

suffering more than in the past from different dynamics, such as the increasingly intense heat waves.[10]
The scientific evidence and the need to make citizens aware of and involved in the changes necessary to achieve the sustainability objectives proposed by the United Nations 2030 Agenda call for urgent and more effective actions to protect the most vulnerable populations in terms of environmental education and participatory processes.[11,12] From this point of view, participatory science has already proved to be a viable approach, with numerous strengths, including fostering lasting partnerships between stakeholders, enhancing skills and increasing awareness among all partners.[13,14] Furthermore, when considering professionals working in the fields of exposure science and environmental epidemiology, the involvement of civil society is a potential ally in tackling the research challenges. Among these, the need for greater compliance with personal and biological monitoring activities, the use of more refined exposure assessment techniques to improve the accuracy in the health impact assessment, and the use of innovative approaches for the identification of exposure determinants and the consequent translation of evidence into agreed public health policies.[15,16]
In this context, two projects based on the participatory approach and involving school children in Milan (Italy) are ongoing since 2018: 1) the MAPS-MI 2018-2019 project "Mapping of air pollution in the catchment area of an elementary school of Milan" and 2) the MAPS-MI 2022-2023 project "Mobility, environment and participation in the schools of Milan". The participatory approach adopted, the objectives, and the implication of these projects are presented here.

# The MAPS-MI approach

## Project themes and goals

The simplified conceptual model, along with the project themes, in order of implementation, are reported in Figure 1. The main activities performed in the MAPS-MI projects are:

- to investigate the commuting habits of school-age children in Milan, the perception of risk and their parents' opinions about mobility and air pollution;
- to investigate air pollution in Milan starting from the schools' catchment areas;
- to educate primary and middle school children on environmental themes, focusing on air pollution and mobility, through ludic workshops;
- to investigate personal exposure of school-aged children to air pollution with a focus on the determinants of exposure and to investigate possible health effects and the role of mediators;
- to co-plan and experiment actions for change, such as collective methods of commuting from home to school (e.g., pedibus, bike to school) and alternative use of the public space (e.g., school streets).

The common thread of this experience is represented by the participatory approach that was introduced to actively involve and raise awareness of children, parents, teachers, and, more generally, citizens living in the study areas.

## Study design, area and project partners

The main target groups of the MAPS-MI projects are primary and middle school children, their parents and teachers. Additionally, the MAPS-MI approach involved residents, associations, and informal groups operating in the school catchment area for the air quality monitoring at fixed sampling points.
So far, the MAPS-MI projects have involved 6 schools in the municipality of Milan (Figure 2), the most densely populated city in northern Italy and one of the most polluted areas in Europe, with more than 3 million residents within its metropolitan area. Here, many air pollutants are mostly traffic-related. The 6 schools were chosen for convenience based on some characteristics, such as implementing projects on active and sustainable mobility and, more generally, on environmental sustainability issues. Besides, pre-existing contacts with the associations of the study areas were decisive in choosing the schools, subsequently playing a fundamental role in the citizen involvement phases. The involved schools are in North and West Milan, in areas characterized by different socio-economic backgrounds.[17]
The projects were approved by the Ethics Committee of the University of Milan and by each school's board. The activities were conducted according to the World Medical Association's Code of Ethics (Declaration of Helsinki) for experiments involving humans.
Engaging activities were proposed to the targets, as shown in Figure 1. The participatory elements adopted during the research process define the used approach as participatory science with alternatively a contributory or a collaborative nature,[18-20] where the control of the process remains unbalanced towards the technical/scientific part.
Three partners with complementary skills necessary to implement the multidisciplinary activities collaborate to the MAPS-MI projects. The University of Milan is responsible for project management, and participatory science, such as air pollution and personal exposure monitoring. The University of Milan Bicocca deals with participatory planning, monitoring, and supervision of environmental education intervention. Finally, ABCittà social cooperative is the main responsible for educational interventions and the whole participatory process, including the actions for change.

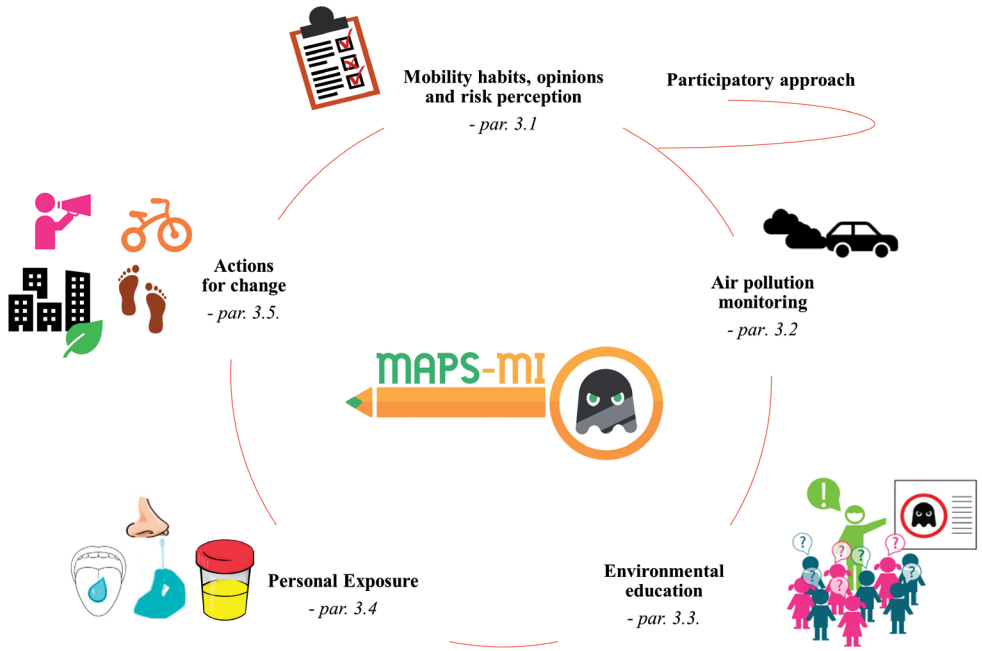


**Figure 1.** Conceptual model of the MAPS-MI projects. Each relevant activity is mentioned; the common thread of the activities is represented by the participatory approach. In the center, the logo of the projects.
**Figura 1.** Modello concettuale dei progetti MAPS-MI. Il filo rosso che tiene insieme i diversi temi affrontati nel processo di ricerca è rappresentato dall'approccio partecipativo. In centro il logo dei progetti.

# Development of project themes

## Mobility habits, opinions, and risk perception

The first engagement action is represented by an online questionnaire distributed among parents to investigate habits, opinions, and risk perceptions on mobility and exposure to air pollution. The questionnaire was conveyed through the schools' main formal (e.g., school director communications to families, school website, student diaries) and informal (e.g., parents messaging groups) communication channels. The questionnaire opens with informed consent and information relating to data processing, followed by the different sections in particular:

- section 1 "Mobility: how do you get around?" investigates the modal choices of parents and their children for home-school commuting;
- section 2 "Opinions on mobility and air pollution" contains questions in the form of "Please indicate how much you agree with the following statements";
- section 3 "Personal information" contains questions aimed at providing an overview of the participants;
- section 4 "Actions for change: bike to school and pedibus" dedicated to the recruitment of parents in the participatory actions promoted by the project.

The questionnaire was developed taking into account previous initiatives headed by ABCittà social cooperative ("pedibus", i.e., "walk together to school"),[21] "Massa Marmocchi - bike to school association" (bike to school),[22] and international experiences such as the Physical activity through sustainable transport approaches project.[23]

## Air pollution monitoring

The air quality monitoring campaign on fixed sampling sites represents the first participatory science action. The considered air pollutants were: Black Carbon (BC) and Volatile Organic Compounds (VOC), which are among the main contaminants linked to combustion processes and to motorised vehicular traffic. BC was selected as representative of fine and ultrafine particles linked with fuel and biomass combustion, as well as an effective indicator of both the effects of local traffic mitigation measures and a tracer that links air pollution to health.[24] BC is also an important climate-changing pollutant, known above all for its decisive role in melting glaciers.[25] VOCs were selected as representative of unburned traffic-related hydrocarbons and for their health impact. Among the others, Benzene, Toluene, Ethylbenzene and Xylene (BTEX) are aromatic compounds, while methyl-tert butyl ether (MTBE), ethyl tert-butyl ether (ETBE) and tert-Amyl methyl ether (TAME) are oxygenated gasoline additives.
More details on the measurement techniques and instrumentation can be found in previous articles.[26,27]
The sampling sites were identified among the proposals of parents of children, associations, and in-

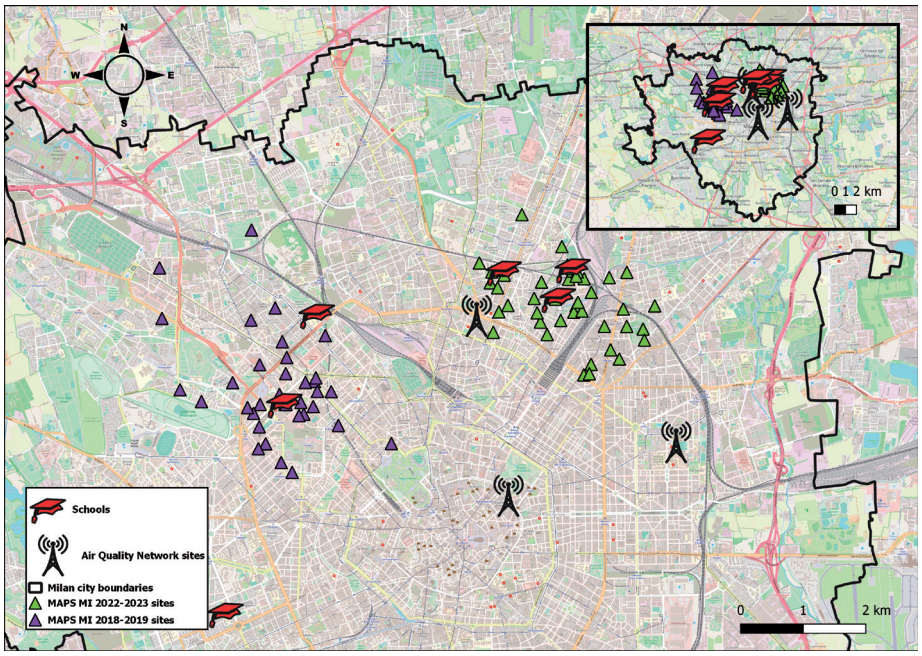


**Figure 2.** Study area of the MAPS-MI projects with involved schools, air quality monitoring sites, and black carbon sampling stations managed by the regional environmental protection agency (ARPA Lombardia).
**Figura 2.** Area di studio dei progetti MAPS-MI con plessi scolastici coinvolti, siti di monitoraggio della qualità dell'aria e centraline preesistenti campionanti black carbon gestite dall'Agenzia per la Protezione Ambientale (ARPA Lombardia).

**Figure 3.** Examples of monitoring sites made available and partly maintained by the civil society. Above on the right, the monitoring unit in detail, consisting of a black carbon sampler with two outputs, one for the sampling tube and one for the energy supply (in this case supplied by the electricity network) and the passive VOC Radiello© sampler (below on the right).
**Figura 3.** Esempi di siti di monitoraggio messi a disposizione e in parte curati dalla società civile. In alto a destra la centralina nel dettaglio, composta da un campionatore di black carbon con due uscite, una per il tubo di campionamento e una per l'alimentazione energetica (in questo caso a rete elettrica) e il campionatore passivo Radiello© per i BTEX (in basso a destra).

formal groups of citizens in the study area. In addition to the questionnaire distributed through the school, recruitment was carried out by means of social media channels (e.g., social street groups), informal networks (active citizens, representatives of institutions), and public meetings organised to present the project.

The main selection criteria for sampling sites were the possibility of installing the sampler at less than 5 meters high and facing the street or other public environments (e.g., pedestrian areas, parks). In order to represent the study area and maximize the potential spatial contrast of air pollutants in the urban environment, both sites overexposed to traffic sources and sites in background positions (e.g., public gardens, pedestrian areas) were selected (Figure 3).

While the VOC passive samplers do not require any maintenance, the monitoring activity of the BC sampler requires the replacement of filters (daily) and the management of the external battery. For these operations, the direct activation of the participants was encouraged and supported by means of a kit with an information sheet and training given during the installation of the samplers (Figure 4). In case the citizen was not available to perform the maintenance activities, these were carried out by operators of the University of Milan supported by a trained volunteer appositely involved from the "BIG - Borgo Intergenerazionale di Greco" project (https://bigreco.it/) headed by the ABCittà cooperative.

## Environmental education

### "Investigation, Vision, Action and Change" (IVAC) method and intervention model

Concerning environmental education, the MAPS-MI approach takes inspiration from the "Investigation, Vision, and Action for Change" (IVAC) method.[28] Starting with an initial introductory meeting focused on the main character, i.e., "black carbon" (hence the project logo, Figure 1), and the definition of the research questions as well as the identification of the areas to be monitored (Figure 5A), the group of school children is involved in some field activities with the air quality scientist and the aim of measuring BC concentrations (Figure 5B). Further, the collected data are presented and interpreted in the class (Figure 5C) to build alternative scenarios for the future (Figure 5D). Finally, some of the actions proposed in the path towards change are tested (Figure 5E).

### From the field experience to the MAPS-MI teaching module

The latest version of the MAPS-MI project (i.e., 2022-2023) includes:

- the environmental education laboratories in the school named "Locatelli-Quasimodo", consisting of two series of workshops with 3/4 meetings per class (both primary and middle classes), considered as a pilot intervention (spring-autumn 2022);
- the design of the consolidated MAPS-MI environ-


**Figure 4.** Air quality monitoring participation kit including BC sampler (A), filter storage tubes (B), replacement filters (C), external battery (D), battery charger (E), and the information sheet (F).
**Figura 4.** Kit di partecipazione al monitoraggio della qualità dell'aria comprensivo di campionatore di BC (A), fiale per la conservazione dei filtri (B), filtri di ricambio (C), batteria esterna (D), carica batteria (E) e manuale d'uso (F).


**Figure 5.** Map of the environmental education laboratories. The project begins by becoming familiar with the figure of black carbon and trying to contextualize the issue in the living environment (A). Subsequently, BC concentration in the school surroundings is investigated (B). The data collected are interpreted in class (C) also to build alternative scenarios for the future (D). Actions for change are finally tested. A concrete example is the awareness campaign co-created and displayed in a public meeting organized at the end of the MAPS-MI 2018-2019 project (E).
**Figura 5.** Mappa degli incontri di educazione ambientale. Il progetto comincia prendendo confidenza con la figura di black carbon e cercando di contestualizzarla nell'ambiente di vita (A). Successivamente si indaga la sua presenza sul territorio (B). I dati raccolti nelle uscite vengono interpretati in classe (C) anche al fine di costruire scenari alternativi per il futuro (D). Le azioni per il cambiamento vengono infine sperimentate. Un esempio concreto è la campagna di sensibilizzazione costruita ed esposta in un incontro pubblico organizzato in chiusura del progetto MAPS-MI 2018-2019 (E).

mental education module by enhancing the pilot intervention, based on the experience and the collected feedback (winter 2022-2023);
- a training intervention involving the teachers of four classes of two additional schools named "Rinnovata Pizzigoni" and "Cardarelli-Massaua (February 2023);
- the implementation of the environmental education module in the new schools (spring 2023) was performed in collaboration with the trained teachers;
- the publication of a website containing project information and materials (second half 2023).

According to a starting scheme, the pilot intervention has been designed and implemented involving the schoolteachers, also with the aim of integrating it into the current teaching. To ensure the effectiveness and continuity of the process, it was decided to involve the fourth-primary and first-middle classes. The evaluation of the intervention and the collection of feedback are among the objectives of the continuous monitoring, which is carried out by means of passive observation in the classroom and interviews with students and teachers. The criticisms and suggestions will contribute to the development of the consolidated MAPS-MI environmental education module. The proposal will be published online and will aim to make the educational experience fully accessible, easily replicable, and usable in different ways, favouring the autonomy of teachers.

## Personal exposure

The personal exposure monitoring activities were carried out in the MAPS-MI 2018-2019 project.

### Informed participation

In the MAPS-MI 2018-2019 project, the environmental education intervention represented the opportunity to involve pupils and parents in personal exposure monitoring. In particular, the recruitment was carried out in parallel with the

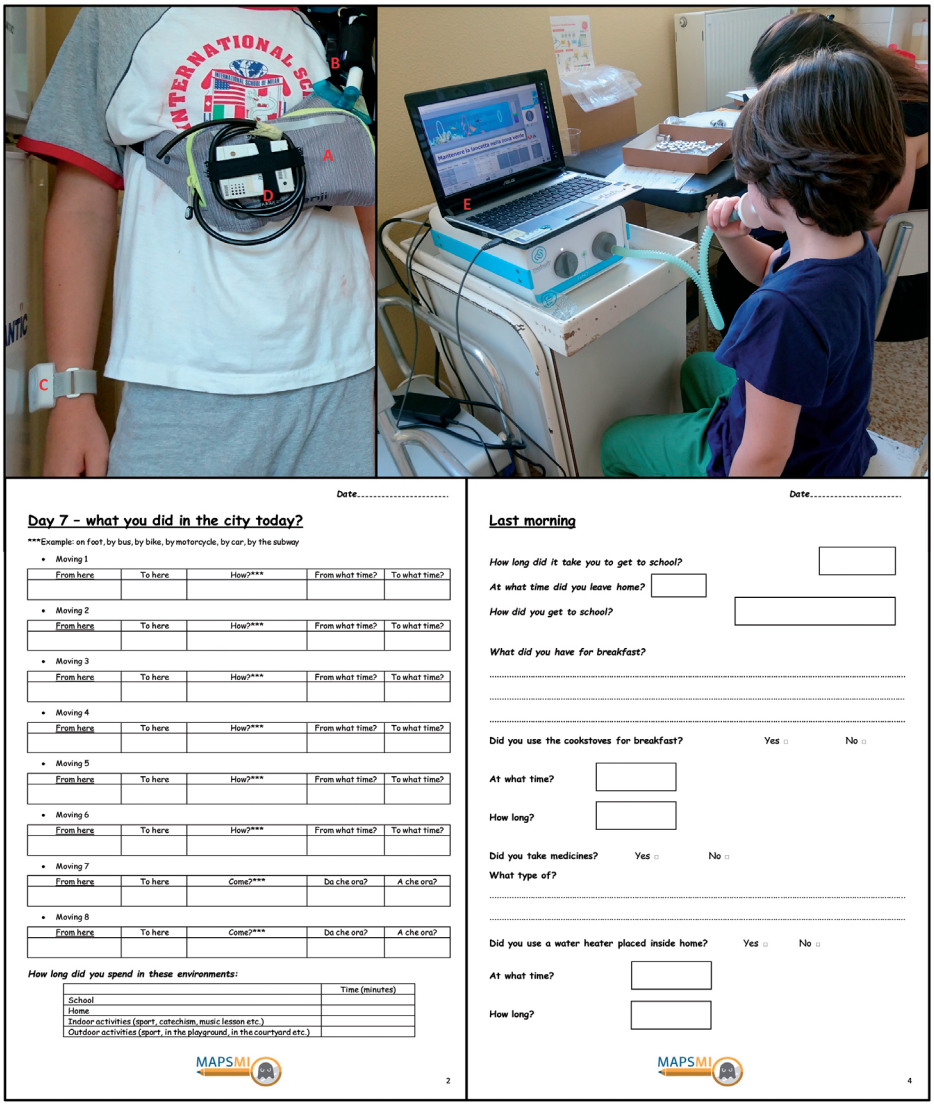


**Figure 6.** Personal exposure and biological monitoring activities in the MAPS-MI approach. Top left, the shoulder bag with the black carbon sampler inside (A), while outside the VOC Radiello© sampler (B), the GPS device (C), and the sensors for some environmental parameters (D). Top right, fraction test of exhaled nitric oxide (FENO)(E). Below, two of the time-activity diary sheets.
**Figura 6.** Le attività di monitoraggio dell'esposizione personale e biologico nell'approccio MAPS-MI. In alto a sinistra la tracolla con all'interno il campionatore di black carbon (A), mentre all'esterno il campionatore di BTEX (B), il gps (C), il sensore per alcuni parametri ambientali (D). In alto a destra il test frazione di ossido nitrico esalato (FENO)(E). In basso due fogli del diario delle attività.

school laboratories and the monitoring activities were presented as part of the environmental education approach. After learning about the role of the researcher during the school laboratories, the students were asked to play the same role during the personal exposure monitoring campaign. In particular, the students were empowered and actively involved by asking them to take care of the sampling tools, collect information on their Time-Activity Diary (TAD, also called researcher's diary), and to collect dust samples at home. The intervention was presented to parents and children with specific information material and subsequently deepened during a specific meeting organised at school.

## Personal exposure and biological monitoring activities design

Monitoring activities were conducted during spring 2018 and repeated during winter 2019. Pupils and parents were asked to give their consent by signing appropriate documents prepared under the General Data Protection Regulation of the European Union (EU, 2016). Pupils were asked to:

* fill in a daily time-activity diary (TAD) (period: 7 days);
- wear a shoulder bag equipped with different samplers (period: day 7).
- collect two dust samples from their room (period: evening of day 7).
- donate samples for biological monitoring (period: at the end of the monitoring).

Figure 6 shows some of the moments and tools that characterized the monitoring activities.
At the same time, parents were asked to fill in a questionnaire to collect personal information (e.g., education, parental smoking habits, health status of the minor, etc.) and to support their children in the tasks assigned to them. To ensure a high level of participation, telephone messages were sent to parents reminding them of the main activities to be performed. All the logistics associated with the monitoring campaign (students/parents' information and training, preparation and maintenance of tools and materials) were carried out in the former medical room of the school with the authorization of the school board.
Concerning the monitoring of personal exposure to air pollutants, a special shoulder bag was set up equipped with BC and VOC samplers and sensors for measuring nitrogen dioxide ($NO_2$), temperature, and humidity (Figure 6). Data downloading and storing were performed systematically at the end of the monitoring period, i.e., once the shoulder bag was returned. As regards the biological monitoring of exposure, children were asked to be involved in:
- collecting a urine sample for the quantification of exposure and effect metabolites;
- collecting a saliva sample for epigenetic analysis;
- collecting a sample of nasal cells for the quantification of the nasal microbiota;
- collecting exhaled air samples to quantify indicators of inflammatory response (i.e., exhaled nitric oxide and carbon oxide).

Finally, by means of a dedicated kit consisting of two swabs and two vials for their storage, the students and their parents were asked to take two samples of dust inside the children' bedroom for quantification of the environmental microbiota.

## Actions for change

In the MAPS-MI approach, the participatory process aims to increase stakeholders' awareness and knowledge of air pollution and mobility. This path sees its fulfillment in the experimentation of sustainability practices. In particular, the intervention focuses on active mobility and urban public space regeneration practices. These actions' participatory planning and experimentation are addressed at both the schools, being part of the educational path, and the community.

### Bike to school and pedibus

The data collected by means of the MAPS-MI questionnaire (see par. *Environmental education*) were processed by the researchers of the University of Milan and shared with the partner ABCittà social cooperative, head of the pedibus Milano project (walking to school in groups of children), and Massa Marmocchi – bike to school association. The addresses of the respondents are used to identify the possible safest and most efficient routes from home to school to be used by the group of children and parents participating in the "bike to school" and "walk to school" initiatives. The identification of the paths is a totally open process, the first data-driven proposal only represents a starting point that is discussed with stakeholders. The identified paths are subsequently tested by the participants. Once the participatory planning process is complete, the final paths are communicated to the school and to the other parents and experimented. At the same time, community involvement is planned to recruit volunteers for morning accompaniments.

### Urban public space regeneration practices

Among the possible actions for change included in the design process, there is the possibility of co-design and experimenting alternative solutions for urban public spaces. For instance, in September 2022, after a meeting with the main local actors (e.g., School, Parents' Association, Municipality), it was decided to request the temporary closure of one of the roads around the school to experiment an alternative use of the roadway space. The day was co-planned with the students involved in the project and inspired by the already successfully tested examples of "school streets". This is the case of the 2019 World Children's Day, which saw the experimentation in 8 school streets in the Municipality of Milan[29] or the workshops organised in Beroldo street by Legambiente NGO with the participation of the MAPS-MI research team. This last event was organised during the "Streets for kids" day of the European "Clean Cities" campaign.[30]

## First results, critical issues, and new scenarios

### Scientific achievements

From the scientific point of view, the active participation of civil society in the monitoring activities has been an added value which helped to collect a large amount of data, reducing at the same time the number of withdrawals, and lost or inadequate data. So far, this approach has made it possible to:
- develop and validate different spatial models focusing on BC dispersion at a neighbourhood scale;[26]
- assess students' personal exposure, and to identify the main determinants of exposure;[27-31]
- validate a model for estimating exposure during

home-school journeys.[32]
This experience has underlined the urgency of implementing traffic restriction policies around schools and along major home-to-school routes to reduce exposure levels of school-age children. The participatory approach also showed its potential in terms of participation to the personal exposure monitoring campaign: here the recruitment response rate was 85% of eligible pupils. Compliance with the proposed activities was also high: for example, out of a total of 180 potentially analysable cases, only 5 (2.7%) were excluded due to the refusal to participate in the biomonitoring (No. 4) or the absence questionnaire (No. 1). Finally, the data deriving from biological monitoring allowed us to highlight the persistent critical issues related to exposure to second-hand smoke in family contexts and those related to the modal choice of daily commuting with children transported by car who appear to have higher urinary benzene values.[27-33] As regards the fixed-site monitoring campaign, thanks to the MAPS-MI 2022-2023 project, the number of sites has increased (from 35 to 77), and a new study area and analytes (VOC) were added. The new data will allow to development spatio-temporal dispersion models with updated state-of-the-art approaches.
So far, the results were presented at different levels: in dedicated events within the school, during advisory commissions of the Municipality of Milan and of local municipalities-boroughs, and at national and international conferences.

## Environmental education

In line with the principle of continuity between school and territory, the MAPS-MI approach represents an opportunity to integrate the institutional, educational curricula with everyday life issues, such as mobility, air quality and urban regeneration. The participatory science process makes it possible to increase the level of sensitivity of students and families attending the school. Furthermore, it generates a sense of responsibility and activates a conscious citizenship. Collectively, these aspects can contribute to the development of environmental resilience in our society. So far, the project workshops have involved around 300 students, 3 first-grade middle classes, and 9 fourth-grade elementary classes.
The first results of the monitoring activities performed by the researchers of the University of Milan Bicocca suggest a high level of appreciation on the part of teachers and pupils. Furthermore, the active participation and the valuable feedback allow to identify the main weaknesses of the experimental approach and the points on which the research team is called to consolidate. As an example, experiential activities in the field allow students to establish concepts with ease and in a more consistent way than more classical classroom activities. On this theme, the teachers suggest being more involved in the preparation of the intervention also by means of specific teaching material, a shared language, and solid theoretical knowledge.

## Challenges and new opportunities

So far, the accumulated experience suggests that the MAPS-MI approach should be further implemented by involving local institutions. To date, the only opportunities of confrontation have been limited to the presentation of the results in specially dedicated municipal committees. A formal partnership could represent an opportunity to implement possible data-driven mitigation interventions (e.g., local traffic restriction measures, structural improvements to encourage active mobility, etc.).
In these terms, the MAPS-MI research team continues to look for opportunities for collaboration. This is the case of the Municipality of Milan's call named "Piazze aperte per ogni scuola"[34] aimed at identifying areas around schools to be regenerated by promoting active mobility and complete traffic restriction. In relation to this call, the MAPS-MI research team is promoting the call within the Pietro Micca (the very first MAPS-MI school), Locatelli-Quasimodo and Rinnovata Pizzigoni schools, encouraging the direct involvement of school institutions, participating in the networks of proposing entities, and supporting the definition of project proposals, also by giving further value to the data collected on the territory.
In terms of a participatory approach, the most recent experiences of collaborative, participatory science in the field of exposure science and environmental epidemiology[35,36] stimulate an ever-greater openness of the scientific process, starting with the co-identification of research questions, methods, and tools. Linked to this is the opportunity to further integrate the know-how of professionals working in the field of social sciences. This can be achieved by studying the relationships between parents' perceptions, knowledge and daily habits, and their children's exposure. Another field of study could be the impact assessment of the MAPS-MI approach on the different behaviour models adopted by stakeholders. Finally, although the most recent living lab experiences[37] inspire the personal exposure monitoring activities, in our project, these activities remain a closed process in which objectives, tools and roles are not subject to negoti-

ation between the parties. Again, a more shared approach starting from the co-planning of the activities, could lead to broadening the design themes, opening up to new collaborative experiences, also with the opportunity to increase the impact of the research.

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