

Sustainable Street Furniture

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Abstract

Street furniture are installed in different locations of a city, are daily used by a large public, and have the closest contact and most dynamic interaction with people and the environment. Hence, they have a great responsibility to benefit the society and urban development. In this paper, we focus on street furniture for adopting the concept of sustainability through the local cities.

This paper presents an experiment which is conducted at Art University of Isfahan (AUI) in order to explore the promises and challenges of designing for deep sustainability within different contexts of the city (Isfahan). The main objective of the experiment is to develop design interventions which affect and guide the community toward sustainability. Specifically students are asked to design street furniture or define an urban intervention which is not neutral but improves sustainability within the context. Finally, the proposed design interventions are evaluated based on their level of success for establishing sustainability. Final results indicate that although a common approach was applied for all the projects in in this experiment, the developed design interventions are not equally contributed to sustainability. While some of the projects only focused on eco-design strategies, some projects succeeded to provide a higher level of sustainability within their context and developed more influential and longer-term sustainable design interventions. It is achieved by the projects that conducted behavioral, social and contextual analysis in order to enhance environmental responsible behavior among the public (e.g. raise public awareness of sustainability, sensate or educate people, or support sustainable behavior). This paper is the extended version of the paper that has been published in the proceedings of the Creative Construction Conference 2018 (Allameh and Heidari, 2018).

Keywords

deep sustainability, eco-design, street furniture, environmentally aware, sustainable behavior

1 Introduction

Global climate change, financial crisis, and the public perception of massive overconsumption, designers are increasingly motivated "to do good for society". In this paper, street furniture are considered as good opportunities to connect with public and promote sustainability within their context. They have a great responsibility to benefit the society and urban development. This is while responsible design and sustainability rarely are the focal points of designing street furniture. According to Rehan (2013), sustainability in street furniture is one of the most important strategies for sustainable urban design. Although comparatively small in scale, street furniture is an element that can play an essential role in developing the quality of urban spaces with added value of representing city identity (Spangenberg, 2013). Gehl (2007) asserts that street furniture also can offer positive social influences on users. Despite with all the possible benefits

given, early observation has found that there is still a lack of understanding towards sustainable design of street furniture. As revealed by Tazilan et al. (2008), over the past decades, sustainable criteria have been lacking or have not been applied to most of the current street furniture designs. This encourage us to focus on street furniture and city installations for adopting the concept of sustainability through the local cities.

2 Sustainability and street furniture

Street furniture can provide different levels of sustainability within the context of a local city (Allameh and Heidari, 2018). Fig. 1 presents the spectrum from a not sustainable design to eco-design and a more environmentally responsible design, which is proposed to be applied in design process of street furniture. According to the proposed framework a deeper level of sustainability is

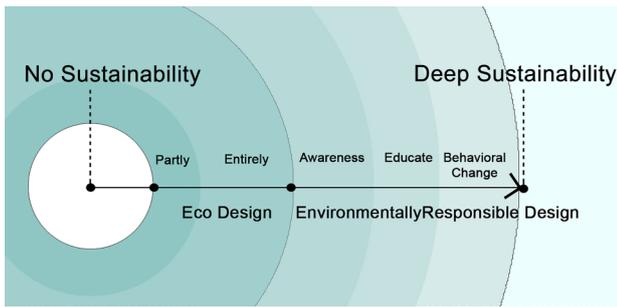


Fig. 1 A move toward deep sustainability in design which includes coming out the white circle of "No sustainability" and moving toward eco design and environmentally responsible design

expected to be achieved if social and behavioral sustainability are accomplished the eco-design strategies.

2.1 Eco- street furniture

Considering environmental issues, designer's responsibilities become more difficult and more important than before. Designers have crucial responsibilities to create environmental friendly products and solutions for the earth. The traditional approach to environmental management has evolved from pollution control, the end-of-pipe approach, to preventive or cleaner production strategies. Some of the fundamental eco-design strategies are reported below:

- Design for Manufacturability,
 - Enabling pollution prevention during manufacturing
 - Design for less material or fewer different materials
 - Design for safer materials and processes
- Design for Longevity,
 - Provide life time period of usage
 - Improve flexibility, modularity and serviceability
 - Design parts/products so that components contain materials with reuse potential in other industries.
- Design for Energy Efficiency,
 - Reduced energy demand during use
 - Use renewable energy
 - Carbon Neutrality
- Design for Modularity,
 - To ease upgrading, serviceability and later disassembly and to delay replacement
 - Multi-functionality and better customized
 - For Longer life
- Design for Dematerialization,
 - Use less virgin material
 - Design products with less mass
 - Reduce packaging
 - Modify manufacturing processes to reduce by-products
 - Maximize use of recycled materials

- Design for Disassembly,
 - To promote re-use of components
 - For quicker and cheaper disassembly
 - For dismantling by simple tools
- Design for Packaging,
 - Minimize packaging or use of sustainable material
 - Rethink selling method or rethink ways to reach the customer
- Design for Logistics,
 - Use of local materials
 - Less transportation or arrange outsourcing to minimize transportation
- Design for Multi-functionality,
 - Use one product for different purposes
 - Design for flexibility to enable changes for different functions, users, times and etc.
- Design for use of recycled materials.
- Design for Recycling,
 - Labeling of parts, especially plastics for easier materials identification
 - Efficient choice of materials (e.g. thermoplastics easier to recycle than thermosets, use of natural, sustainable materials)
 - Modify manufacturing processes so that by-products can be recycled
 - Design with less variety of materials
 - Use of materials that can be locally recycled
 - Design for greater materials recovery
 - Design for safer disposal of non-recyclables
 - Design for economic recycling, arrange for marketing incentives to promote recycling.

Recently, it has become clear that such interventions must be more radical and go beyond the redesigning of existing products in order to catalyze a transition towards a sustainable society. Design for Sustainability (DfS) goes beyond these eco-design strategies. DfS integrates social, economic, environmental and institutional aspects and offers opportunities to get involved one's own identity beyond consuming standardized mass products (Spangenberg, 2013). DfS suggests that a typical win-win situation is not only the eco-efficiency of production, but also the eco-efficiency of consumption and sustainable consumption (Spangenberg, 2013). A product is efficient if the abovementioned eco-design strategies are applied in its design process, and if the use efficiency of this product can also be extremely low (most of the time the product is not used). Hence, detecting possibilities for improvement of socio-cultural rather than technical,

like improving the use intensity can lead to better results in eco-design and is a step forward to design for sustainability (Allameh and Heidari, 2018). Choosing bicycle instead of car in the Netherland is one the best successful examples of sustainable consumption instead of focusing on making that product eco efficient. The need for sustainable behavior introduces a relatively new issue into the global debate on sustainable development. Sustainable behavior questions, not only products and services but also the way that needs and wants are defined and fulfilled (Vezzoli, 2003). This means that designers need to be made aware of their new responsibilities and to become competent to make specific contributions in the transition towards a sustainable society.

Accordingly, this paper aims to explore the possibilities of promoting sustainable behaviors through the cities by developing new ideas for street furniture. The research discusses implementation of street furniture which drives the community towards a deep sustainability. While the common examples of street furniture are functionally designed ignoring the important roles that they can play in the urban living, some emerging trends are applied in the literature in order to increase the benefits of street furniture for the city and the environment; the examples are as follows:

- Multifunctional ICT devices like a bus station, which acts as a cloud device and includes screens that display real-time information about bus movements and touch-screens that provide access to interactive maps, local news, tourist information as well as a USB charging port for mobile devices and advertising.
- Responsive Street Furniture, which adapts to the needs of individuals. The adaptations include brighter street lighting, audio information, extra places to use and more time to cross the road.
- Sustainable Technology like Energy Solar LED Street Lamps or roads with renewable energy use.
- Modular Street Furniture
- Flexible or Pop-Up, Hydraulic Power Units, Furniture (Hassanein, 2014).

2.2 Street furniture for raising awareness of sustainability

Since street furniture has the closest contact and most dynamic interaction with people and the urban environment (Siu and Wan, 2011), it can be applied for giving messages to the public. There are scattered examples of street furniture in the literature that aim to catch public

attention to the environmental issues. The floating Plastic island installation (Luzinterruptus, 2018) in Portugal is one the examples which is made of 5000 recycled plastic bottles. It replicates, at a smaller scale, the so-called "eighth continent" made of plastic and garbage which is alarmingly taking over great areas of the Pacific. Rain Interactive installation (Luzinterruptus, 2018) in London is another example which highlights the vital need of water and how abhorrent it is to privatize it and trade it for the profit of just a few. The labyrinth of plastic waste (Luzinterruptus, 2018) in Poland, the Rising Moon installation (Daydreamers Design, 2013) at Victoria Park in Hong Kong and the glowing labyrinth of plastic waste (Luzinterruptus, 2018) which placed around the plaza's statue of King Philip III in Madrid are other examples that demonstrate, in a poetic manner, the amount of plastic waste that is consumed daily, in addition to focusing attention on the big business of bottling water. The Tetris-shaped street furniture (Tsikoti, 2015) located within a city park in Córdoba, Argentina, is another remarkable example that is designed to teach passerby about sustainability issues. These unique seats and tables showcase recyclable materials like plastic bottles, cans, and paper, and feature easy-to-understand eco-facts written on the surface of each piece. Wikado Playground in the Netherlands is a renovation of play area, which is built from recycled wind turbine blades. The blades were cut up into parts to serve as tunnels, towers, bridges, hills, ramps and slides. Such a kind of design solutions provide a sustainable process for dealing with wind turbines at the end of their service life is needed in order to maximize the environmental benefits of wind power from a life cycle approach. Most components of a wind turbine such as foundation, tower, components of the gear box and generator are already recyclable and treated accordingly. Nevertheless, wind turbine blades represent a challenge due to the materials used and their complex composition (Skelton, 2017). Moreover, playing in this playground can sensate children to environmental issues and improve their understanding of the importance of recycling and reusing materials. Park(ing) Day is one of the successful events to call attention to a lack of public green spaces and high car usage (Rebar Group, 2011). It was started by Rebar, a San Francisco art and design studio and has become a global movement that takes place on the third Friday of each September. In a Park(ing) Day, metered parking places are changed to a public park and recreational space.

While, such types of design interventions can sensate the public to the sustainability, sustainable behavior are not expected to be attained. However, they are considered as an initial step toward shaping a sustainable society (Allameh and Heidari, 2018).

2.3 Street furniture for promoting sustainable behavior

A product is not a neutral intermediary, but a mediator that actively mediates the relation between a user and his or her environment. Tromp et al. (2011) used the example of the microwave to show that design would influence behavior patterns even implicitly and unintentionally. Utilizing microwave make families join together for fewer dinners than they did before because the microwave oven has made it so easy to quickly heat up an individual meal. This example shows that products can mediate certain behavior even without determining it. Accordingly street furniture is sometime deliberately designed to change behavior in order to prevent an undesired behavior or to encourage a desired behavior (Allameh and Heidari, 2018). Tromp et al. (2011) introduces four different types of influence on user experiences, namely, coercive, decisive, persuasive, and seductive.

Coercive refers to a definite prevention of an undesired behavior. Speed bump, speed limit camera are the examples of a coercive intervention to stop risky driving behavior by making a punishment for the undesired behavior. Making a perceivable barrier for undesired behavior (pain) or making unacceptable user behavior overt (shame) are also considered as the examples of coercive strategy for changing behavior. Decisive strategy is making the desired behavior a necessary activity to perform. Customize receptacles with different openings for trash, recyclable objects (e.g. bottles and papers) is an example of a decisive intervention.

While coercive and decisive are strong types of design interventions and lead to a definite change of behavior, their effects seems to be temporary and not deep on people. Meaning that people would follow their own behavioral patterns in case of removing the barriers and interventions. Fogg (2009) introduced the term of persuasive design that aims to alter attitudes or behaviors of users through persuasion and social influence, but not through coercion. Poor little fish basin (Healey, 2011) designed by designer Yan Lu is an example of persuasive design, which is an emotional feedback device for saving water. Social Stairs, the Piano Staircase (Peeters et al., 2013) is another persuasive design which encouraged people to take the stairs in favor of the elevator by triggering new motivations. Their study

on the resulted behavioral changes revealed a high level of long-term social engagement. Push, the Talking Trash Can, can be considered as a persuasive design. It is a radio-controlled robot which makes daily rounds throughout Tomorrowland at Disneyland and Disney California Adventure Park, Hong Kong Disneyland Park, Disneyland Paris, Tokyo Disneyland in Japan. Visitors are entertained by interactions with Push that verbally accosts passersby (Yang et al., 2015). The Dutch theme park De Efteling has similar recycling bins named "Holle Bolle Gijs". Typically this character calls: "Paper here" and when you feed him some rubbish, he will thank you politely. Children and adults take trash from the ground and stuff them in the mouth of Holle Bolle Gijs just to hear the gobbler talk to them (Wever et al., 2006).

Seductive is another design intervention which can lead to a changed behavior unconsciously by triggering human tendencies for automatic behavioral responses. Woonerfs the "living streets" are the best examples of this design intervention. The concept of the woonerf was developed in the late 1960s in the city of Delft, Netherlands (Ben-Joseph, 1995). Residents of a neighborhood were upset with cut-through traffic speeding through their neighborhood, making it unsafe. They believe eye contact and human interaction are more effective means to achieve and maintain attractive and safe areas than signs and rules. Hence, they initiated woonref, in which the street is shared among pedestrians, bicyclists, and motor vehicles. But pedestrians have priority over cars. The street is designed without a clear division between pedestrian and auto space (i.e., no continuous curb), so motorists automatically slow down and travel with caution (Ben-Joseph, 1995).

3 Case study: design experiment on sustainable street furniture

According to Deniz (2016), designers generally assume that their area of responsibility is limited to function and appearance and rarely spread through the effects of their designs on people and environment no matter what their scale is (Deniz, 2016). The ability to conceive and practice a type of design that acts as a catalyst for something beyond the immediate product and holds the responsibility in positively influencing entails a shift in the definition of professional profiles and education. Hence, design practices increasingly need to go beyond styling trends, consider environmental threats, recognize social and behavioral gaps and design to fill the gaps.

At Art University of Isfahan, an experiment was conducted in order to explore the promises and challenges of designing for deep sustainability within different contexts of the Isfahan city (Allameh and Heidari, 2018). The experiment explored how designers can set their own holistic approach to sustainability in design, place social awareness, responsibility and behavior in perspective. Accordingly, the experiment was conducted at Industrial Design Group of AUI under the template of a bachelor design studio course, an exemplary for a regular street furniture design course. The course has been offered for many years in a broad spectrum of disciplines as aesthetics, ergonomics, manufacturability, market considerations, but not sustainability. Through this experiment, an increased emphasis on environmental issues and sustainability was practiced. The main objective of the experiment was to develop design interventions which affect and guide the society toward sustainability. Specifically students were asked to design a city installation or street furniture which is not neutral but improves the sustainability within their context. Accordingly the developed design interventions need to apply the following strategies:

- Eco-design (e.g. minimizing the environmental impact, using natural, recycled and recyclable materials, dematerialization, extending product lifecycle).
- Raise public awareness of sustainability.
- Educate and sensate public on sustainability.
- Promote sustainable behavior with any of the design strategies for changing behavior, namely, coercive, decisive, persuasive, and seductive.

Students are encouraged to define urban design interventions for establishing a deeper level of sustainability in the society. There was not one or more predefined subjects in this experiment. Students needed to research on the existing environmental and social problems through the city and defined their own design solution to address the challenges. Hence, recognition and treatment of pain using the power of design was the leading directions of the projects. In the following, the developed design interventions are discussed.

3.1 Flexible modular kiosk¹

Paying attention to the flexibility in street furniture like kiosk is the starting point of this project. Accordingly the street kiosks can be more durable and better adapt

to different functions in different times and different locations of the city. The project follows eco-friendly strategies in defining the materials, joints, modularity and etc. However it does not focus on promoting sustainable behavior within the society (see Fig. 2).

3.2 Eco Social Parklet²

Chaos in pedestrian routs, mixing the behavioral territories, lack of seating and common areas in the crowded pedestrian streets and lack of social interactions bring out the idea of these eco parklets. The Parklets are pavement-reuse initiative and enhance green spaces of the cities. With temporary and lightweight structures. They are designed to improve the quality of environment through the pedestrian streets. The proposed eco parklets resemble natural islands within the crowded streets and enhance social interactions. Hence, this design intervention can be considered as seductive design which tries to promote positive social behavior among public (see Fig. 3).

3.3 Sober Pot, an interactive urban flower pot³

Regarding the increased worldwide consumption of paper in recent times and the significant environmental impact of paper, reusing waste papers in design is the leading point of this project. Accordingly, multiple critical flower pots are made of compressed waste papers. The sober pots are interactive installations that can protect their plant from being touched; if someone approaches them, the top part of the pot will smoothly come down and the pot will rotate in order to restrict access to the flowers. When numbers of people around the plant increase, two plates of the pot will completely coincide to hide the central plant like a shell protecting its pearl. Such a kind of fearful reactions from the pot is viewed as the result of irresponsible human behavior towards the nature. Accordingly, the pots aim to give a message on the ignored nature in the current polluted cities. (see Fig. 4).

3.4 Holy Circle, an eco-aware drinking fountain⁴

The nature is massively ignored in our modern life. Looking back to the history reveals that the nature and its elements were highly respectful. This project aims to catch people's attention to the respectful nature through their urban life. Hence, cultural forms and symbols are

¹ Designed by: AUI industrial design students, Molood Tavakoli, Majid Majidi

² Designed by: AUI industrial design student, Marzieh Rahmati

³ Designed by: AUI industrial design student, Molood Tavakoli

⁴ Designed by: AUI industrial design student, Zeinab Abtahi



Fig. 2 The developed design interventions for sustainability during the experiment:
 Flexible modular kiosk



Fig. 3 The developed design interventions for sustainability during the experiment:
 Modular eco street furniture



Fig. 4 The developed design interventions for sustainability during the experiment:
 Sober Pot, an interactive urban flower pot

recreated to make an urban pot combined with a drinking fountain. Form of the pot reminds an element of ancient Persia which mythically protected the mankind and the nature. Wasted water from the fountain irrigates the plant underneath the fountain and gives a massage on the need for more careful water consumption. By giving value to the plant and water, the pot aims to sensate the public on environmental issues (see Fig. 5).



Fig. 5 The developed design interventions for sustainability during the experiment:
 Holy Circle, an eco-aware drinking fountain

3.5 Urban Recycling Tool⁵

With regard to the little efforts made for public awareness on environmental issues in Iran, the project proposes the idea of an urban recycling tool. The tool is able to recycle plastics and change them to Lego for kids.

The Lego's are made of multiple pieces that are shaping different heritage buildings of the city. So each time that people deliver PETs, they can build up a new piece of Lego and make the building puzzle complete. According to the (Iranian Department of Environment, 2018), the usage of plastic in Iran is 3 times larger than the universal average usage. This project gives people the opportunity to gain information on overuse habits, get experiences in recycling processes and encourage them to collect their plastic wastes in order to make their own Lego pieces. Hence, the project not only sensate and educate the public, but also engage them in sustainable behavior (see Fig. 6).

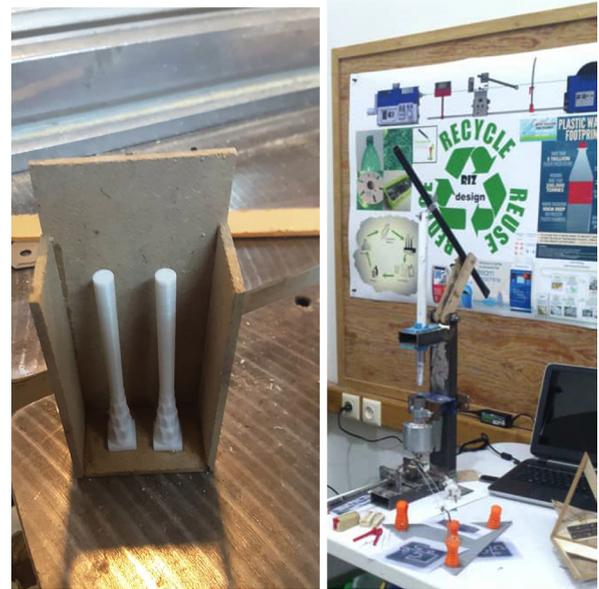


Fig. 6 The developed design interventions for sustainability during the experiment:
 Urban Recycling Tool

3.6 Spirit of Waste⁶

Littering is a highly diffused anti-environmental and anti-social behavior, especially among kids. Spirit of waste is a new expression of trash bin caring for the environment. The main objective of this project is designing a trash bin in order to encourage kids to collect and split waste. The bin is characterized as a spirit of waste who loves to eat papers and plastics. It follows not only eco-design strategies but also persuasive and seductive design. Because it encourages kids to do an environmental friendly activity in a playful manner (see Fig. 7).



Fig. 7 The developed design interventions for sustainability during the experiment:
 Spirit of Waste

3.7 Green Air Bicycle Station⁷

This bicycle station aims to promote cycling in an interactive way. It is made of a parametric wall (representing a smoky air) which will turn into a green wall when a bicycle is rented. As soon as a bike is go out from the station, the sensors will notice and actuate the related wall section to rotate and to turn into a green wall. The more bicycles are rented out, the greener the wall will be. Such a kind of interactive design solutions for bicycle stations can sensate people on negative effects of massive daily use of cars on air quality of the city and stimulate green mobility behavior in the city (see Fig. 8).

⁵ Designed by: AUI industrial design student, Maleki Rizzi

⁶ Designed by: AUI industrial design student, Reyhaneh Rahmani yar

⁷ Designed by: AUI industrial design student, Zahra Torki

3.8 Bin the Butt⁸

As well as plastics, cigarette filters are comprised of thousands of chemical ingredients, including arsenic, lead and nicotine, all of which can leak into marine environments. Bin the Butt project aims to raise awareness amongst

⁸ Designed by: AUI industrial design student, Alireza Fatemi



Fig. 8 The developed design interventions for sustainability during the experiment: Green Air Bicycle Station

smokers and highlight the link between the cigarette butt they drop on the street or down the drain and the impact it has on the environment. It contains a displaying surface which counts the number of every added butt in the bin and shows a message of its impacts on fishes and the environment. The interactive bin also can be used for citizen voting, football match polling and can include other persuasive interactions in order to attract smokers to throw their cigarette butt in the bin. The aim of this project is to design an interactive bin for the urban environment to limit the cigarette butts littering behavior in an engaging and effective way (see Fig. 9).

4 Evaluation and categorization of the designed street furniture based on sustainability

Evaluating the design interventions shows that the experiment leads to expand design context in thinking and practicing something beneficial for the society. Most of the students' projects not only apply eco design strategies but also include social, behavioral and contextual aspects in design in order to create sustainable street furniture.



Fig. 9 The developed design interventions for sustainability during the experiment: Bin the Butt

However, the developed cases of street furniture are not equally contributed with social community to promote sustainability and enhance environmental responsible behavior. While the cases with critical design interventions like the Sober Pot and Holy Circle projects can raise public awareness on environmental threats and sensate people toward more sustainable behavior in the long term, it is too ambitious to expect they can cause any significant behavioral change towards sustainability among people in the short term. But design interventions such as Spirit of Waste and Urban Recycling Tool that engages community in sustainable activities and educates sustainable living tips are expected to be more influential in moving toward sustainability. Green Air Bicycle Station and Bin the Buts projects may seem to be extravagance in initial impressions, but can be considered as a cultural investment. Combining street furniture design with social design and designing street furniture that is not only functional but promotes sustainable behavior is suggested to be seen as a future trend in sustainable design.

5 Conclusion

It is vital that future designers get an understanding of how social impacts may affect or may be affected by their designs and decisions. It should be acknowledged that sustainable education need to have some type of a higher calling, which may be social responsibility and public design. Designers need to have heightened awareness of their contributions to environmental degradation. Accordingly, the paper proposed to deepen the design of smart furniture from functionally designed and eco-design to a more influential design for sustainability. Outcomes of the study clear that sustainability is supposed to be more than just purely environmental issues, and should in general refer to "beneficial to society". Accordingly, a design-based experiment was conducted at Art University of Isfahan in order to change perceptions of students by making use of the "value-added" criteria's to design process and practice design for promoting sustainability among the society. While the developed design interventions of the conducted experiment tried to have the least environmental effects, their focal point was to have a multi-layered design; meaning that they aimed to address the existing needs of a city life in an expressive manner. For instance, an urban bin should be rubbish removal in a city and correctly contains wastes, but it can also play more role in the city by engaging children in an interesting game, teaching them how to separate trash for recycling and encouraging them to keep the streets and the environment clean. An urban drinking water should satisfy the thirst of

people, but it also can create different drinking experiences and simultaneously give strong messages on the value of water and the importance of water conservation. A city bike station should provide multiple renting bikes, but it also can contribute to promote cycling behavior in an interactive way. By such a kind of design interventions, street furniture are

no longer inactive objects in urban life but be alive and communicative to people. Outcomes of the study reveals that sustainable street furniture can effectively act as a facilitator to sensate people on serious social and environmental problems, make them thinking on these issues, even influence on people behavior by promoting sustainable behavior.

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