

Human-Centred Technology for Sustainable Development Goals - Workshop Results

Kamila Rios da Hora Rodrigues¹[0000-0001-9176-8709], Vânia Paula de Almeida Neris²[0000-0002-4059-8700], Lara Piccolo³[0000-0001-6503-8016], and Masood Masoodian⁴[0000-0003-3861-6321]

¹ Institute of Mathematical and Computer Sciences, University of São Paulo (ICMC/USP), Brazil

² Department of Computing, Federal University of São Carlos (UFSCar), Brazil

³ Knowledge Media Institute (KMi), Open University, UK

⁴ School of Arts, Design and Architecture, Aalto University, Finland

Abstract. This paper presents the results of the workshop on Human-centred Technologies for Sustainable Development Goals (HCT4SDG) - Challenges and Opportunities. The workshop was part of the 18th International Conference promoted by the IFIP Technical Committee 13 on Human-Computer Interaction (Interact 2021). Nine papers were presented by authors from several different countries and discussed in the workshop. Six of these papers were extended in this proceedings. After discussion, seven challenges and eight research opportunities were listed as expression of the participants' views on HCT4SDG.

Keywords: Sustainability · Sustainable development goals · Human-centred design · Human-centred technologies

1 Introduction

The 2030 Agenda for Sustainable Development adopted by the United Nations (UN) Members calls for global partnerships to achieve significant advances in fairness and prosperity in the world. This includes equal access to, and management of resources such as water, energy, climate, oceans, urbanization, transport, science and technology. These themes are addressed as a set of 17 UN Sustainable Development Goals (SDGs)⁵ intended to be achieved by the year 2030. These goals should be achieved uniformly across the nations, dissolving the well-established dichotomy of *developed* and *developing* contexts [2].

In line with this agenda, we understand *sustainability* more broadly, beyond the environmental aspects related to solutions that do not harm the environment, to include also the social aspects related to human rights, respecting differences, and the dissemination of values that are the basis of the continuance of life in society for future generations [3-5].

According to Blevis [1], sustainability can, and should be, a central focus of interaction design. The author believes that for a perspective of sustainability,

⁵ <https://sdgs.un.org/goals>

“design is defined as an act of choosing among or informing choices of future ways of being. This perspective of sustainability is presented in terms of design values, methods, and reasoning”.

Addressing technology design for sustainable development goals with a human-centred approach demands rethinking the way technological solutions are developed and consumed, and considering the situated design solutions and their impact in the social, economic and environmental aspects. As stated in Neris, Rodrigues e Silva [3], this should be used by designers as an opportunity to establish a bridge between the real-life, with its inequalities and injustices, and the ideal world, as aspired by the UN SDGs.

1.1 Objectives

With this broad perspective of *sustainability* in mind, the objective of this workshop was to build an agenda which aims to define challenges and opportunities for design of interactive technologies that address one or more SDGs with a holistic view.

Topics of interest included:

- IoT and smart communities;
- Environmental monitoring;
- Design solutions that support sustainable behaviour;
- Green computing;
- Ethical aspects of green computing;
- Equality and fairness in access to technology;
- Sustainable design;
- Design for sustainability.

The workshop engaged the participants in sharing research on the theme, in a broad sense considering several different UN SDGs, and discussing challenges and obstacles related to creating human-centred technology towards advancing the sustainable development goals (HCT4SDG).

2 Workshop activities and participants

This one day workshop was structured to be engaging, practice-oriented, hands-on, and participatory. The workshop started with the participants’ presentations, focusing on their main research interest and design approaches to advance the SDGs.

The papers selected were divided into 3 main groups for presentation, namely: 1) Behaviour and Awareness, 2) Technology and 3) Education and Beyond Technology - SDGs 3 and 5 (Health and Gender).

The works added in the group *Behaviour and Awareness* were:

- Extreme Citizen Science Contributions to Sustainable Development Goals: Challenges and Opportunities of a Human-Centred Design Approach

- An Action-Management Video Game to Foster Sustainability Through Garbage Recycling
- Envirofy: Behaviour Change Wheel based Tool for Sustainable Online Grocery Shopping
- Striving to increase self-sufficiency: design and evaluation of a smart energy dashboard for prosumers with solar panels

In the group *Technology and Education* were presented the following works:

- Internet of Things in Education for Sustainable Development
- Interactive Map Visualizations for Supporting Environmental Sustainable Development Goals
- Guidelines for the Sustainable Development of Computing Technology

In the group *Beyond technology - SDGs 3 and 5 (Health and Gender)* were presented the following works:

- An Informatics-based Approach for Sustainable Management of Factors Affecting the Spread of Infectious Diseases
- Women Techno-education and Sustainability

Authors had about 15 minutes to present each paper, followed by 5 minutes for discussion. More details on the workshop program are available at the workshop website⁶.

A Padlet supported the discussions on each paper. Participants were invited to write questions and comments about the paper that was being presented. The posts included clarification questions, suggestions for future work and also some preliminary challenge and opportunities closely related to the topics being discussed. Figure 1 illustrates some of the questions and comments that raised from the paper presentations.

After all presentations, a discussion was carried out as presented in section 4. Finally, for wrapping up, a round of thoughts was conducted and some publication plans were announced.

In the next section, the six papers extended to this proceedings are presented.

3 Papers extended

The works presented in the workshop were invited for extension and possible publications in two different means of publication: a journal and this extended proceedings. Authors of six papers accepted the invitation to extend their work and publish here. The works are:

An Action-Management Video Game to Foster Sustainability Through Garbage Recycling: It is proposed video game offers to post-adolescent players educational contents about garbage recycling, implementing a gameplay that merges the Action and Management game genres with a pixel-art inspired

⁶ <https://lifes.dc.ufscar.br/HCT4SDG>

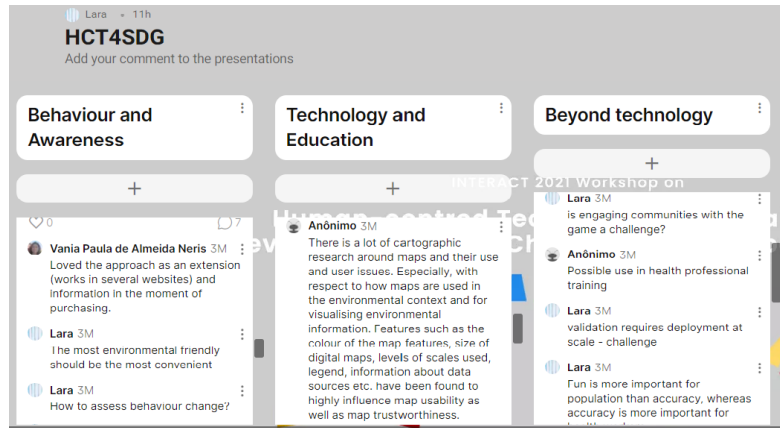


Fig. 1. Part of the Padlet with some questions and comments from the participants.

graphic style. A preliminary user-based evaluation has been performed with three players using the Thinking Aloud technique. Comments about the game mechanics were generally positive and the sustainability topic was perceived well-integrated and non-invasive, proving the need of further experimentation and evaluation.

Extreme Citizen Science Contributions to Sustainable Development Goals: Challenges and Opportunities for a Human-Centred Design Approach: The authors focus on Extreme Citizen Science, which includes a set of situated, bottom up practices, used for environmental monitoring purposes and for recording local indigenous knowledge, mainly in the Global South. They present and discuss in this paper the human-centered approach that the implementation of extreme citizen science requires, they identify and present the challenges they face as well as the opportunities that extreme citizen science initiatives create for contributing to Sustainable Development Goals.

Interactive Map Visualizations for Supporting Environmental Sustainable Development Goals: The authors present a summary overview of the main factors that need to be considered when designing interactive map visualizations in support of the SDGs. They also provide a few example of the use of interactive maps in web-based information systems, decision support systems, and computer games that focus on environmental issues.

An Informatics-based Approach for Sustainable Management of Factors Affecting the Spread of Infectious Diseases: The paper presents an informatics-based approach to the management and monitoring of infectious diseases, in the context of one of these SDGs focusing on the eradication of vector-borne diseases such as malaria, Zika and other neglected tropical diseases. The authors outline the challenges faced by many conventional approaches to ecoepidemiological modelling and proposes a distributed interactive architecture for teamwork coordination, and data integration at different levels of informa-

tion, and across disciplines. This approach is illustrated by an application to the surveillance of leishmaniasis, a neglected tropical disease, in remote regions.

Guidelines for the Sustainable Development of Computing Technology: The authors has formalized a set of recommendations to guide the designers in the creation of computational solutions, and thus allow the sustainability factors in design to be considered. The guidelines were applied in an academic scenario and three specialists evaluated the solutions made with and without them. The results suggest that the guidelines supported the sustainable development of Computing technologies.

Internet of Things in Education for Sustainable Development: The authors discuss some potential roles of technology, more specifically the Internet of Things (IoT), with a human-centred design perspective to be applied in Education for Sustainable Development (ESD). They propose some preliminary guidelines to apply IoT-based projects to educate and empower students related to environmental Sustainable Development Goals and illustrate these guidelines with a practical project on ultraviolet radiation measurement.

4 Challenges and Opportunities on HCT4SDG

After the presentation of the papers, we had a discussion section about the participants' views on challenges and opportunities for HCT4SDG. This activity was supported by another Padlet with only two columns: one for the challenges and another one for the opportunities. The board was shown on sharing screen and one organizer was responsible for filling in the board while the discussion was happening.

Seven challenges were written on the board. They are:

- Think beyond research questions. Consider impact.
- Compromise when making environmental decisions.
- Consider sustainability as a transdisciplinary issue.
- Trigger trust.
- Involve different stakeholders, including policy makers.
- Not misinform people by showing a single perspective (or a slice of the problem) trivializing issues.

On the other hand, opportunities to be explored were also mentioned and discussed. Eight opportunities were written on the board. They are:

- Address misinformation on SDGs.
- Fill knowledge gaps.
- Consider trustfulness between people (people may trust more other people than institutions).
- Propose sustainable development guidelines for developers.
- Consider personalization and emotions for improving engagement and awareness.
- SDGs are generic, but we have to address individual needs.
- Build tools to support decision-making "in real life". Bridging willingness with reliable data.
- Develop serious games and/or educational tools.

5 Final remarks

This paper presented the results of the HCT4SDG workshop that was part of the Interact 2021 program. In this one-day workshop, nine papers were presented and participants discussed several challenges and opportunities for improving the state-of-the-art in this field. It is interesting to highlight that researchers from several countries submitted papers and joined the workshop, emphasizing that research on this theme is globally needed. Moreover, different research contributions were presented including games and maps visualizations, but also guidelines and approaches, for instance.

A participatory approach was adopted and Padlets were used to support discussions. From the authors' experiences and perspectives, research challenges and opportunities in this field were listed. The challenges ranged from involving different stakeholders to triggering trust and considering the impact of the research. Several and broad opportunities towards human-centred technology for the SDGs were also discussed, including addressing individuals' needs, considering trustfulness between people, and also the development of guidelines for developers.

Acknowledgement. This workshop was supported by the IFIP Working Group 13.10 on Human-Centred Technology for Sustainability. For more information please visit: 4se.hs-augsburg.de/wg13-10/.

References

1. Blevins, E.: Sustainable interaction design: Invention & disposal, renewal & reuse. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. p. 503–512. CHI '07, Association for Computing Machinery, New York, NY, USA (2007). <https://doi.org/10.1145/1240624.1240705>, <https://doi.org/10.1145/1240624.1240705>
2. Kumar, N., Cannanure, V.K., Gamage, D., Prabhakar, A.S., Sturm, C., Loaiza, C.R., Sabie, D., Bhuiyan, M.M., Moreno Rocha, M.A.: Hci across borders and sustainable development goals. In: Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems. p. 1–8. CHI EA '20, Association for Computing Machinery, New York, NY, USA (2020). <https://doi.org/10.1145/3334480.3375067>, <https://doi-org.libezproxy.open.ac.uk/10.1145/3334480.3375067>
3. Neris, V., Rodrigues, K., Silva, J.: The future, smart cities and sustainability. In: I GrandIHC - BR Grand Research Challenges in Human-Computer Interaction in Brazil. Human-Computer Interaction Special Committee (CEIHC) of the Brazilian Computer Society (SBC) (2015)
4. Neris, V.P., Rodrigues, K.R., Silva, J.: Futuro, cidades inteligentes e sustentabilidade. GrandIHC-BR—Grandes Desafios de Pesquisa em Interação Humano-Computador no Brasil pp. 16–18 (2012)
5. de Santana, V.F., Neris, V.P.A., Rodrigues, K.R.H., Oliveira, R., Galindo, N.: Activity of brazilian hci community from 2012 to 2017 in the context of the challenge 'future, smart cities, and sustainability'. In: Proceedings of the XVI Brazilian Symposium on Human Factors in Computing Systems. IHC 2017, Association for Computing Machinery,

New York, NY, USA (2017). <https://doi.org/10.1145/3160504.3160562>,
<https://doi.org/10.1145/3160504.3160562>