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Social imaginaries methods and socio-engineering competences in sustainable river management (a case study in the living lab Upper Citarum)

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Abstract. The Living Lab approach has become popular and developed in the past decade. It could provide a configuration to pursue a shared vision of integrated water resources management of the Citarum River in West Java - Indonesia. The multi-stakeholder situation and the growing recognition of interdependencies among stakeholders foster the complexity of addressing sustainable river management for the Upper Citarum River. To gain insights on essential competencies and adaptations in higher education curricula, the Environmental Engineering Department of the Faculty of Civil and Environmental Engineering-ITB, Telkom University Indonesia, and Van Hall Larenstein University of Applied Sciences, Netherlands, joined hands in a collaborative research project. This study aims to develop a socio-engineering aspect for sustainable river water quality management in the Environmental Engineering Field and Curricula. The methods used are social imaginaries of Participatory Mapping and a Poetry Route that allowed the involved river bank communities to activate their role and take positions in the living lab. Institutional stakeholders, acting in a facilitating role, learned to gain and share information from and with the community. The result concludes that social imaginaries methods enable a new perspective in developing community-based programs and advocate further exploring the socio-engineering competencies of environmental professionals.

1. Introduction

Citarum River, West Java Province, represents the poor water resources management in Indonesia. Most of the major rivers in Java Island are severely polluted due to anthropogenic activities, i.e., domestic, industrial, agricultural, etc. [1-4]. Citarum River restoration efforts have been on the agenda for many years, spending substantial local and central government funds with no significant results. Ginkel described that the water management in the Upper Citarum River Basin is strongly affected by a decentralisation policy with considerable autonomy of local governments [5]. In 2018, the Citarum Harum program was started by the special Citarum Watershed Team. This new program for Citarum River has strong ambitions to clean the river through sustainable river management. As can be observed

in the diversity of governmental stakeholders which will collaborate with science, governance, business, and citizens such programs require transdisciplinary multi-stakeholder approaches.

A transdisciplinary approach to sustainable water management faces an array of technical, social, and political challenges and the water management policy arena has become complex by the increasing rates of unpredictability and uncertainty in the face of global environmental change. This complexity is also fostered by the multi-stakeholder situation and the growing recognition of interdependence among stakeholders. Addressing the complexity requires water management to shift from 'government' to 'governance' and to collective decision-making by different parties. In Living Labs as a governance model, the recognition of riverbank communities as stakeholders requires other living lab partners to be able to deal with community-based approaches to foster stewardship of rivers. A challenge in this respect could be recognizing the vision of the communities as socio-cultural gaps may exist between communities or the general public and institutional stakeholders. In such line of thinking, Taylor referred to inclusive and participatory governance approaches as important for building resilience of Indonesian riverbank communities [6].

The concept of Living Labs as a form of governance has emerged in European regions. Living Labs serve as a transdisciplinary approach for collaborative experimentation of academia, citizens, companies, and government actors [7]. Transdisciplinary multi-stakeholder approaches, enabled through collaboration and learning between science, state administrations, business, and citizens to achieve sustainability ambitions is also called the 'quadruple helix'. Living Labs define as "physical regions or virtual realities where stakeholders form public-private-people partnerships (4Ps) of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products and systems in real-life contexts" [8].

The Living Lab Upper Citarum aims to act on the requirement to build solid stakeholder cooperation and community support to restore the river Upper Citarum. The operational approach adopted in the Living Lab Upper Citarum aligns with the ABCD roadmap or the framework for sustainable development (Figure 1).
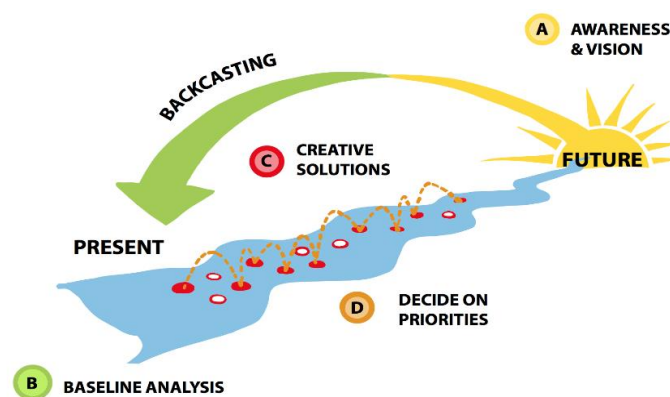
Figure 1. ABCD roadmap, the framework for sustainable development [8].

The Living Lab Upper Citarum is considered a sound and relevant collaborative space for the university partners to take up the role of knowledge institute. The Living Lab partnership also enables lecturers and students to practice professional competencies and meet contemporary educational goals according to their respective curricula while addressing the complexity of Citarum sustainable river management. In this context, the living lab Upper-Citarum provides a space for social learning in the real-life environment as an essential ingredient to respond to pressing challenges and transform the socio-ecological dynamics of water resources [9].

While knowledge institutes increasingly collaborate with policymakers, entrepreneurs, and the general public to facilitate such 'quadruple helix' learning and innovation processes in a real-life environment they rethink the relevance of formal and eventually non-formal elements of their curricula.

As Universities aim to play a key role in living lab approaches, socio- engineering and social learning skills such as critical thinking, reflexivity, media literacies, creative methodologies, horizontal communication processes, and the facilitation of Living Lab processes require a reconsideration as, these skills are rarely integrated into formal engineering and life sciences curricula.

To enhance the functioning of the Living Lab Upper Citarum, the main design principles for Living Labs as defined by Witteveen, et. al. provide guidance in the adaptation of higher education curricula. These design principles indicate that to make a Living Lab operational and impactful, it should create a learning space that fosters inclusive 'quadruple helix' participation, creates authentic learning environments that focus on a sustainable future, stimulates reflexivity in learning and innovation for sustainability, and facilitates interaction, knowledge sharing, and open system management [12].

Applying these design principles requires Living Lab stakeholders and partners to reposition the conventional collaboration with local communities reacting to institutional interventions. Institutional stakeholders therefore, need to rethink the role and qualifications of Living Lab facilitators to achieve the ambitions of the Living Lab. Van der Steen et. al. refers to a focus on legitimacy and coordination to reconsider what he calls public values of civil servants [11]. Van Tatenhove [12] and other authors also call for such a re-articulation of the role of government stakeholders and other partners in a living lab approach also referring to accountability and reflexivity.

The concern about facilitation competences as an essential part of achieving Living Labs' performance aligns with curriculum development considerations at Institute of Technology, Bandung (ITB). The ITB Academic Senate has considered the expertise needed by ITB graduates to answer 21st-century challenges to face complexity and diversity, such as written in a Decree No.11/SK/I1-SA/OT/2012 [13]. The ITB Academic Senate mentions that graduates must be able to apply a lifelong learning to provide the most up-to-date knowledge and information; systems thinking, which is the ability to understand how a system is fully working to obtain a perspective or a comprehensive picture of the system, including assessing, analyzing, evaluating, making decisions, and describing how the elements in a system interact with each other; non-routine problem solving, which incorporates the ability to diagnose and develop problem-solving strategies that are non-routine, to develop metacognitive capacity in the form of creative and innovative reflection on the accuracy of the selected problem-solving strategy; and working in cross-disciplinary teams and being responsive to contemporary issues.

2. Methods

A social imaginaries approach was adopted to shape the ABCD roadmap (Figure 1). The aim was twofold: designing a process appropriate for experiential learning for the Living Lab Upper Citarum facilitators and offering artistic, creative, and innovative strategies for participating communities. The research methods strategy combined skills training for Living Lab partners, which would constitute an experimental space to explore skills and competencies that are supportive and trainable to increase the performance of a Living Lab configuration. A learning space was created in which Living Lab partners from diverse institutions act as facilitator trainees in Living Lab Upper Citarum community-based activities. New skills and competencies were introduced and further explored by putting them into practice at the location of involved riverbank communities. This approach aligns with the suggestion to create pilots in the Living Lab that are stepping-stones in the long-term government vision of the Upper Citarum Living Lab.

The social imaginaries concept can be defined as "A way of ordinary people imagining their social surroundings; it is not merely a social theory because it is carried in images, stories, and legends rather than theoretical formulations" [14]. Social imaginaries can be expressed in images and stories of popular and artistic expressions based on community values and principles, fantasies, motivations, institutions, and rules. The product of social imaginaries gives meaning and presence to their surroundings and positions all members in relation to one another. Other authors, such as Svasek [15], elaborate on creativity as a way of expressing, which is not just merely spontaneous but can be seen as a surprising, emotional process with both elements of repetition and creating new configurations. Sarco-Thomas [16]

describes stewardship resulting from community art as an ecological practice, mentioning 'active relationship with their environment' and 'sensitivity towards the real world' as outcomes. Based on the above, this research aims to look for the key factors towards a successful Living Lab Upper Citarum and how to enhance the competencies and strategies of Living Lab facilitators to organize processes of participation, learning design, reflexivity, and facilitation in cooperation with all stakeholders, including the directly involved and affected local communities to enhance the governance of sustainable river management. Social imaginaries concepts are introduced in this research to give a multidiscipline approach to the environmental engineering field to handle sustainable river water management.

In the context of the sustainability transition for the management of the Citarum River, this research project departs from recognizing the quality of arts-based methods described by Ingalls (2012, p.101 quoted by Fenge & Cutts, [17] as to "engage in conversation and communities that might otherwise be inaccessible to them." Using such methods coincides with governance models, which articulate the effectiveness of experimental and innovative approaches in the early stages of governance transformation [18]. The research being addressed in this article acted on long-term partnerships between Indonesian and Dutch universities that share concerns over integrating contemporary or 21st-century skills and competencies in water governance and river management. The research explored the skills and competencies required to facilitate transdisciplinary Living Lab community-based activities. The methods in the Living Lab Upper Citarum are in focus, using social imaginaries methods facilitated by staff members of institutions partnering in the living lab and students from two universities.

The chosen strategy allowed participating staff members to gain experience with the creative methodologies. At the same time, implementing the social imaginaries methods envisioned contributes to the environmental challenges of the Living Lab Upper Citarum. The focus is on technological solutions rather than co-creation with the involved communities. The learning space was designed to be conducive and relevant for the institutional participants, the involved community, and the living lab. The training was designed and implemented with expertise in creative methodologies, community art, and community participation.

This research focused on exploring two social imaginaries methods for public participation to gain insight into their impact and facilitation by the trainees: (a) a Participatory Mapping exercise and (b) the creation of a Poetry Route inspired by a similar project of the river IJssel in the Netherlands. One of the project's aims was "challenging people to reflect on a sustainability agenda inspired by the Poetry Route to change the debate from merely political debate on vested interests to clashes between the present and future wishes and needs" [10].

2.1. Social imaginaries methods in the living lab Upper Citarum

The institutional partners of Living Lab Upper Citarum consist of district, city, and provincial government representatives, industry associations related to industrial waste management and control, non-governmental organizations, the central government represented by the Ministry of Public Works, and universities. Motivated to support the Living Labs performance, each stakeholder institution sent representatives to participate in the activities for two weeks. Participants in the facilitation training were, amongst others: Local Government-Bandung Regency: Environmental Protection Agency and The Planning and Housing Agency (Dispertakim), West Java Province: The Environmental Protection Agency (DLH), Human Resources Development Agency (BPSDM) and Regional Development Planning Agency (Bappeda), Ministry of Public Works: The River Watershed Agency of Citarum (BBWS-Citarum), Industry: Indonesian Association for Environmental Pollution Control (APPLI), Academia: University of Padjadjaran (UNPAD), Institut Teknologi Nasional (ITENAS), University of Telkom, Institut Teknologi Bandung (ITB).

These representatives are involved as the participating trainees in the research. Students from two Bandung universities, ITB and Telkom, joined as research assistants while participating as trainees. The project activities began with facilitation training comprising a kick-off meeting and a workshop with the institutional trainees and students. The kick-off session introduced Living Lab concepts and a conceptual framework of the research. The workshop provided training on the selected social imaginaries methods

following an experiential learning approach. The institutional trainees engaged in the methods employed in the riverbank communities. The workshop was completed with further explanation and discussion with the trainees on their role as facilitators during the community-based activities (Figure 2).


Figure 2. Workshop on selected social imaginaries methods for the facilitator's trainees.

The following day, the research team and the trainees traveled to Kampong Ciwalengke and Sukahaji in Majalaya Sub-District, Bandung Regency. After an introduction, the research team and the trainees familiarised the community members with Participatory Mapping. The community members were invited to draw a map of their house in the morning, indicating family members and their activities. In the next stage, they put together their maps to create a collective map of their Kampong. While compiling the community map, the layout of the houses, the river, the road, and the location of their water sources, sewerage, and other infrastructure were deliberated. After initial hesitations, the process became dynamic and supported and may also hindered by the group of outsiders constituted by the research team members, students' assistants, and trainees. With pieces of paper moving around, connected and torn apart, consent was reached, and the compilation of the village emerged Figure 3.

Figure 3. Participatory mapping with Ciwalengke community [19].
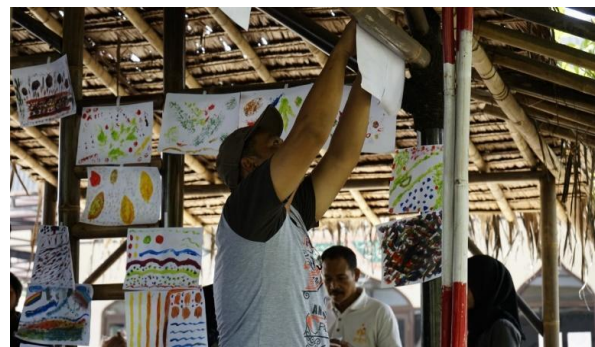
Figure 4: Community members hanging their paintings in the 'community museum' [19].

On the second day in the community, we focus on creating a Poetry Route as a method of social imaginaries and community art. The activities were implemented with the same communities in Majalaya. After a brief introduction, all villagers engaged in painting exercises while the trainee facilitators took care to stimulate relaxation and creativity while the community members painted their views about Citarum. All resulting paintings were collected and hung in the meeting place's open structure called the 'Ciwalengke Community Art Museum,' as shown in Figure 4. Exposing the artworks enhanced the conducive and creative atmosphere and prepared for future activities. The day was closed

with a tribute to the painting by the primary facilitator, indicating specific details of the paintings to call attention to a particular color, shape, and different brush strokes, which showed the expressions and emotions of the painter.

The next session focused on the communities expressing their thoughts and aspirations for Citarum River through poetry. Community members were invited to reflect on their current and future Citarum perceptions in eight sentences or more. In a quiet, reflective sphere, all participants took papers and started scribbling, striking out, and back to writing (Figure 5). Once the poems were finished, they were read out aloud and collectively matched with an accompanying painting. The poems and accompanying paintings were again exhibited in the 'Ciwalengke Art Museum'.

Figure 5. Community members writing their aspirations for Citarum River through poetry [19].

All materials from the activities were collected for post-production. The map of Ciwalengke and Sukahaji was prepared and printed on A3 paper. Two coinciding processes took place with the poems and the paintings to organize the creative output for designing and printing the Poetry Route. Text editing took place, sometimes combining several poems to ensure all villagers were recognized as authors in the final Poetry Route. The poems were translated into the English language to have a bi-lingual production. The selected paintings were prepared with limited added design to maintain the authentic character while ensuring the legibility of the combined poems and paintings. The poems were prepared for printing on canvas banners with the painting in the background. The artworks come together in the Poetry Route "Suara Citarum - The Voice of Citarum".

2.2. Social imaginaries methods for information and experience sharing among communities and stakeholders
The project's next stage brought the Participatory Mapping and Poetry Route results to other communities. The research team, the trainee facilitators, and student assistants traveled with ten Ciwalengke and Sukahaji Village representatives to downstream Cipaku Village, Banjaran Sub-district. Participants of this session were local NGOs such as Elingan NGO, representatives from Bandung District EPA, West Java Province EPA, Bandung District Housing and Settlement Office, APPLI, and West Java Human Resources Development Agency. In the afternoon, the Ministry of Environment and Forestry representatives visited the session as they were nearby and were interested in activities.

The attendees split into four groups, each including representatives from all communities. The map of the Majalaya Community (see Figure 6) was made available to each group and explained by Ciwalengke and Sukahaji community members from Majalaya. Based on the map, villagers from Banjaran were invited to join the conversation and to share similarities and differences in issues and conditions in their area based on the observation of the map. The mapping conversations were followed by sharing the Poetry Route "Suara Citarum – Voices of Citarum" with Cipaku Village. Participating writers and painters were invited to read aloud their poems. In wrapping up the encounter, the communities coincided in the similarities of their main problems, i.e., solid waste management, water supply, sanitation, and flood in the rainy season. Inspired by the good results of the solid waste management initiative in Sukahaji, the participants of the other communities approved that having a

waste/recycling bank and a scheduled waste collection by the authorities could help solve the current problem as waste is being disposed of in piles along the street and burned. The participants also shared a similar interest in digging deep wells for their community to gain access to clean water.
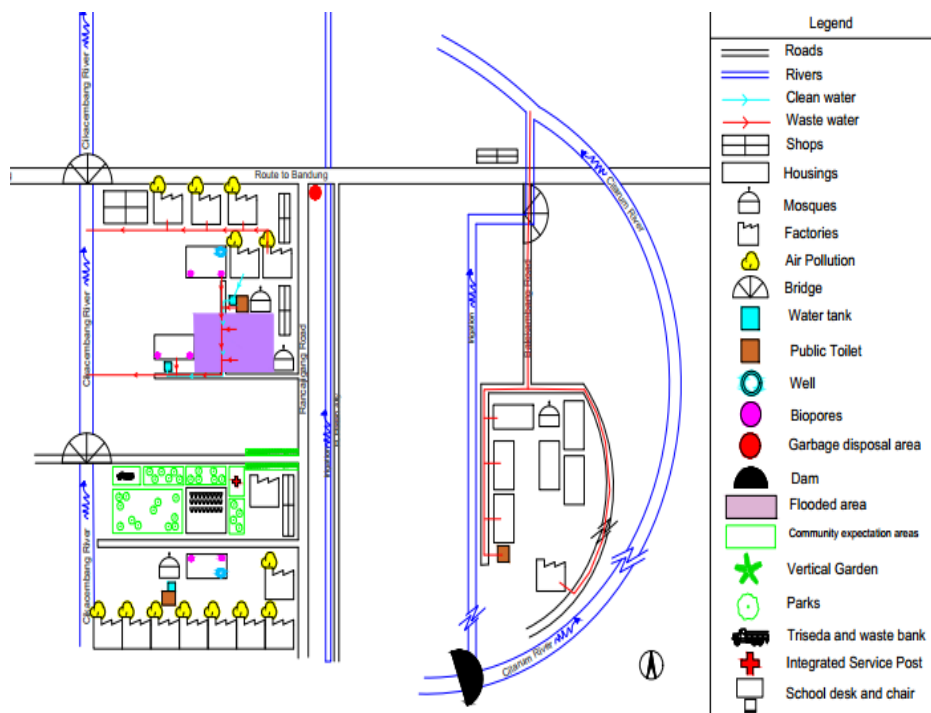
Figure 6: Participatory map of Majalaya community.

The map of the Upper Citarum communities and the 12 banners of the Poetry Route were exhibited in a mini-symposium conducted with institutional and academic partners participating in or with interest in the Living Lab, such as government and academia alumnae Association of Environmental Engineering (IATL) and consulting companies. The conclusive brainstorming discussion was to use the inspiration of the research project to propose contributions from the government, academia, IATL (alumnae association of environmental engineering), consulting companies, and others to support the Living Lab Upper Citarum. Some examples of proposed activities are presented in Table 1.

Table 1. Examples of proposed contribution from the symposium's participants.

Participants	Proposed Activities
Government	1. Development of communal wastewater treatment plant infrastructure 2. Building appropriate coordinating mechanisms within the governmental agencies to ensure sustainable communications with other stakeholders 3. Integrating river management and tourism (e.g., Citarum as the tourism river
Academia	1. Producing the results of the Poetry Route as a popular book to increase readerships, especially among young people 2. Directing research, community development programs, and student activities in Citarum 3. Promoting Living Lab activities on social media 4. Identifying innovative ways for clean water supply, e.g., water vending machine

Table 1. Examples of proposed contribution from the symposium's participants (cont.).

Participants	Proposed Activities
IATL (Association of Environmental Engineers of Indonesia)	1. Assisting all districts to have clear action plans for managing environmental problems. This can be achieved by providing the local governments with various activities/projects/studies that have been conducted by academia and consulting companies 2. Being a center of excellence to replicate the Living Lab concept into the higher tier or in other locations

3. Results and Discussions

The evaluation of the preparatory training for institutional trainees indicated that trainees were unfamiliar with these methods but by experiencing the activities they gain a glimpse of how the process would unfold. See Figure 2 for an impression of the workshop for the facilitator trainees. Trainees stated that the new methods would challenge the existing competencies of Living Lab facilitators; trainees realized the potential and relevant qualities of the methods for living lab community-based activities. Some participants with a mere technical background described their limited familiarity with the social aspects of such interdisciplinary approaches. One participant from West Java Province - Human Resources Development in West Java Province - mentioned that Participatory Mapping and Poetry Route were new and could be developed in their curricula. Most participants expressed in the evaluation that the workshop method was exciting and that the trained methods were applicable to their respective institutions or organizations.

The mapping exercise, taking place on the ground as can be observed in Figure 3, enabled the community participants to crawl around with pieces of paper representing their houses, the market, and a road to discuss the layout of their Kampong and similarly required the trainees to join them in the workspace which was unusual to them. As the activity continued and the trainees experienced how the mapping assignment documented the environmental problems in the area, the sense of unfamiliarity evaporated in the lively induced conversation. Since two Kampongs were involved in this activity with each a different environmental condition, these exchanges continued to a deeper discussion between both communities. The mapping exercise resulted in a shared vision of their respective Kampong and how to implement it. The trainees observed how the first steps of the ABCD roadmap of the Framework for Strategic Sustainable Development (Figure 1) took shape in the reality of implementing the living lab approach in the river bank communities. The Participatory Mapping process and results provided more precise information to Living Lab facilitators from various institutions and organizations. They better understood the community's lived reality, perceptions, and imaginaries concerning environmental problems and water resources management.

Trainees observed differences in detail in the maps between Sukahaji and Ciwalengke. Despite being neighboring communities, the produced map had shown that there were a few key differences. For example, both Kampongs are within an industrial area. However, Sukahaji receives clean water from industrial funding (CSR project) and has a proper waste management system, while Ciwalengke does not. On the other hand, Sukahaji experiences floods more often compared to Ciwalengke. After realizing such sharp differences in neighboring communities, a representative shared insights with the other community. The head of the Sukahaji community explained that he had often attended activities and programs regarding community development. Through that experience, he conducted community training for utilizing recycled waste and better waste management. This discussion and activity raised awareness for both Sukahaji and Ciwalengke community members on what they lack and lack of. It triggered conversations on how they can duplicate the other community's program to develop their community. Based on all outcomes, a map of Ciwalengke and Sukahaji was compiled in one Majalaya Community map (Figure 6).

The trainees undoubtedly observed how the community members joined the painting and poem writing assignments in an open manner and how they were very proud of their art work when exhibited

in the 'museum'. The reading of the poems and the active engagement of the community while finding sound matches of painting and poem impressed the trainees. Trainees realized that their mindsets of expecting 'shy' community members required re-interpretation of their expectations as presumptions. The production of the poetry route was a new experience for both the communities and the trainee facilitators. Some community members explained that this was their first time using brushes and acrylic paint, thus increasing their excitement and intention with their paintings. The creators of the poems and paintings felt visibly proud of their work as they received applause, and it was observed that the audience felt inspired by witnessing 'Cry of Citarum', 'A prayer' and 'For our grandchildren' to mention some of the titles. The trainees wondered to what extent the meaning of the poems could be collectively absorbed as the communities still seemed to be engaged in dynamic conversations resulting from the previous activities. Students involved in this experiment mentioned exciting results, especially for the Environmental Engineering Department students, regarding enhancing their communication ability in the community. These results align with evaluations showing that communication ability in the field is essential to students' success in compiling their final assignments.

The activities in Kampong Ciwalengke and Sukahaji in Majalaya and Kampong Cipaku, Banjaran have been organized in cooperation with the Environmental NGO Elingan and have been announced in advance to the participating community members. Academic principles of informed consent were adhered to during all activities inspired by the concept of visual informed consent as described by Lie & Witteveen (2015). Community members reacted actively to conversations about their engagement and permission regarding particular in the process.

The interest in the visual informed consent approach was put into practice by the Telkom students. The activity and the recording of events articulated a general interest in ethical issues and a broader discussion on the meaning of participation and empowerment amongst all participating facilitators. The Telkom students were initially resisting or hesitating towards the recording of the informed consent procedure. It was not understood how this could be of any interest to any audience. Informed consent is a new issue for students. In Indonesian culture, people usually respond positively to university students' activities. Permission before an activity in a legal letter and proposal is only needed by government officials and corporations, not for society. Telkom student Rahman stated, "we just say that the interview video is for course assignment before recording, and the informants usually do not bother it." In the video documenting the events, the consent was expressed as "We are happy because what is presented is quite transparent. Hopefully, this image brings a message for anyone who sees it, and this message hopefully becomes a solution to the environmental changes".

The encounter in Bajaran was an unexpected experience for trainees and students. The trainees recognized the strength of the Participatory Mapping exercise as conversations were dedicated and focused. It was also realized that once initiated, the conversations required more time than expected since the resulting exchange between members of the different communities had a flow that exceeded the established time frame. A critical reflection followed the recognition that the impact created with the poetry route amongst the community members is tangible and practical; the series of banners requires a good placing. The poetry route deserves a space to position its attractiveness, recognition, and impact. It was appreciated that the community art producers received generous acknowledgment of their work while being present in a live session shaped by their work. The trainees concluded that the event again gave evidence of the potential strength of community-based interventions and described how they initially had underestimated these social imaginaries methods.

The trainee facilitators indicated how they gained access to local knowledge and perceptions of environmental issues. Through observation, listening, and facilitation tasks, they could experience the interaction and communication between the community, local government, and industry. The trainees and other Living Lab partners expressed interest in observing communities sharing positive ambitions for a clean environment. The experiences obtained during the project activities developed a connection among the trainees and developed a clearer understanding of the diversity of life along the Citarum River. This understanding enabled the trainee facilitators to consider more appropriate contributions to the community according to their respective institutional roles. Also, the mini-symposium induced

ambitions for concrete contributions and follow-up. The regency and provincial government described several activities in this area but were not sustained due to several problems. The NGOs intend to support and help any community program related to river water quality improvement.

The university facilitators proposed roles as mediators between industries, local government, and the community. Involved students proposed to use their final assignment or thesis as a potential research collaboration in the Living Lab. The local government and industry representatives also gained insight into their surrounding community's concerns and were allowed to share their perspectives on the issue. This listening and exchange established a connection and respect between communities and stakeholders due to the transparency of communication. The communities and stakeholders engaged in the conversation acknowledged that collaboration is critical to achieving a clean and healthy environment.

The positive experiences and expectations for follow-up expressed by the communities articulated the responsibility trainees carry when creating such expectations; participation is not just about doing things together in one place; participation makes facilitators accountable to ensure they act on promises made in the process.

4. Conclusion

The project activities confirm that the community-based methods and creating social imaginaries are promising pathways to a Living Labs approach in the Upper Citarum River. The methods have qualities to contribute to or shape the stage of awareness and vision and to the baseline analysis in the context of the ABCD roadmap model. Similar methods will contribute to the stage of creative solutions, which is the third stage of the sustainable development framework. The inclusive and creative approach of the Participatory Mapping and Poetry Route methods to participatory governance has strategic potential, as experienced in the Living Lab Upper Citarum. However, implementing this innovative approach and communication method requires training for facilitators from governmental and non-governmental organizations to achieve optimum results. The experiments described here indicate that Living Lab (Upper Citarum) requires facilitators in the role of 'process-designers' referring to spaces that enable participation, communication, learning, knowledge sharing, and co-creation, legitimized by the relevance of the issue at stake and the attractive invitational qualities of the space.

The active involvement of diverse stakeholders with different backgrounds and different institutional interests as (trainee-) facilitators revealed that the coordination and communication among the Living Lab Upper Citarum River stakeholders pose a challenge. This will enable institutional stakeholders to design and propose activities according to the community's needs and search for alignment with their respective institutional policies and interests. A quest for training contemporary skills to such an end is gaining ground. There is a need for new professionalism in competencies such as critical thinking, reflexivity, media literacies, creative methodologies, and horizontal communication processes, and this is recognized for training institutional staff and prospective professionals or students. The poetry route made the trainees and students, as' outsiders, realize that the lived reality of the river bank community does link to a specific type of knowledge. This is easily overlooked as expertise resulting from formal education, or functional authoritative functions are more often recognized and respected than non-formal knowledge. The conversations during the mapping activities show a strong awareness of sustainability issues at the community level. The social imaginaries portrayed in the poetry route have been interpreted as promising and convincing signs of stewardship. The dialogue between the communities even stronger expressed the sense of collective imaginaries, concerns, and responsibility, which are all founding elements of stewardship. The exchange with a downstream community provided evidence for the transferability of the methods and thereby supports the need for the policy of higher education institutes to address contemporary challenges and establish curricula that enable graduates to face complexity and diverse knowledge. These outcomes align with the design principles for Living Labs and the competencies mentioned by the ITB academic senate, which were described in the introductory section.

The research inspired reconsidering curricula in higher education from a transdisciplinary perspective on learning and research. As the urgency of transformative processes for sustainable river management increases, conventional approaches to curriculum adaptation may fall short. In line with

the previously mentioned design principles, it was articulated that all educational institutes can learn and actualize their curriculum from experimental spaces created by this Living Lab research.

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