INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
7 & 8 SEPTEMBER 2017, OSLO AND AKERSHUS UNIVERSITY COLLEGE OF APPLIED SCIENCES, NORWAY

# INTERACTIONAL CO-DESIGN AND CO-PRODUCTION THROUGH SHARED DIALOGUE WORKSHOPS

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**ABSTRACT**
In 2017 660 million people remain without sustainable access to safe drinking water [1]. The majority of these are in rural areas with little hope in the foreseeable future of access to distributed treated water systems. Solar water disinfection (SODIS) is a household water treatment using solar energy to inactivate pathogens in water stored in transparent containers placed in direct sunlight. SODIS is used by approximately 5 million people in developing countries daily [2], but uptake is slowing. The WATERSPOUTT project aims to increase user uptake of SODIS by designing, piloting and manufacturing technologies including solar jerry cans and solar-ceramic filtration. These are being designed in a multi-disciplinary collaboration between designers, engineers, health and social scientists and end users in Europe and Africa. This is achieved through co-design activities, context analysis and stakeholder dialogue workshops which aim to ensure that product designs meet both the technical and social needs of the more than 100 million potential end users in Africa. Examples of student design work highlight the importance of this shared dialogue and changes in design thinking that are evolving through the co-design approach. Through producing designs which are readily accepted and widely adopted in the case study communities, this paper addresses issues relevant to the topics of social issues in design education and new design education paradigms. It also addresses the wider theme of building community: design education for a sustainable future by showing how transdisciplinary approaches can ensure community engagement and design adoption.

*Keywords: Co-Design, Co-Production, Transdisciplinary Design, Community Engagement..*

## 1 INTRODUCTION

WATERSPOUTT (WATER - Sustainable Point-Of-Use Treatment Technologies) is an EU Horizon 2020 funded project consisting of 18 partners in 12 countries across Europe and Africa. The aim of the project is to design, develop, manufacture and test solar based purification technologies for treating drinking water at point of use. These designs will be piloted and assessed for impact on waterborne disease in four sub-Saharan African communities - Malawi, Ethiopia, Uganda and South Africa. Multinational teams of designers, engineers, health and social scientists begin with a detailed analysis of the social, political and economic context of water use, wants, needs and vulnerabilities in these communities. Design work builds on this integrated understanding to create socially accepted and locally adapted technologies, and the development of educational and training materials to help ensure wide adoption and long term sustainability. This paper explores how the shared dialogue workshops for co-design and co-production have been developed and implemented. WATERSPOUTT's major aim will be achieved through social design and localised adaptation of that design in the four case study areas. The case studies, which connect scientific data to local knowledge and are built in cognisance of the local gendered socio-economic culture, are designed and developed with a view to scaling up access and usage to regional level. This paper looks at the Malawi study to design, produce and manage the adoption of a ceramic water filter system, and explores the integrated model of working.

## 2 METHODOLOGY

The case studies of interactional co-design, production and piloting of new designs and technologies are achieving integration through a range of methods including:

(a) Shared Dialogue Workshops (SDWs) led by social scientists which engage designers, engineers, scientists, stakeholders and potential beneficiary communities. These SDWs provide support and evidence for the technical and social activities considered in the designs.
(b) Context analysis to determine the impact of water rights, conflict, governance and gender on water access and treatment choices.
(c) Co-design activities between European and African institutions.

(a) **Shared Dialogue Workshops**

SDWs are central to the co-design process, and take place every six months, with eight over the four year project. Discussions and outputs are captured, and cover all facets of the continuing dialogue between stakeholders throughout product development and testing. SDWs vary in their participation but can include a range of stakeholders including academics from social and physical sciences, technicians, educators, politicians, practitioners, community leaders, and household members. The workshops form a learning-by-doing process where participants identify the strengths, weaknesses, opportunities and threats for the uptake of the solar technologies at household, community and regional level. This format helps clarify attitudes, beliefs and perceptions of individual members of households in the community. SDWs use systematic techniques to engage local populations, to support reflection, attitudes and critique of the technologies and the responses to those of the designers. In doing so they also build the capacity of all to understand the social context of the product's use, its adaptation or rejection.

(b) **Context Analysis**

Social scientists in Malawi have completed extensive reviews of the following with a focus on water: Statistical profiles; Colonial and post-colonial histories; Class disparities and conflicts; Gender relations; Religion and ethnicity; National water structures, governance and decision making models. These reports are prepared for publication by the social science team within WATERSPOUTT.

(c) **Co-design**

As this project is both multidisciplinary and ranges over 18 partner countries it is imperative that communication and dialogue is maintained with relation to design at all times. To achieve this, the following activities are undertaken:

(i) Scientists on visits to case-study areas take field notes that summarise their interactions with, directions given to and decisions made in relation to local stakeholders as they occur in the field.
(ii) Scientists in labs take notes about decisions and prioritisation (or not) of social factors that they are taking into consideration in their design.
(iii) Social scientists in each case-study area are on hand when scientists are in the field to (a) organise or/and attend meetings between scientists and community people and workers, (b) organise the facilitation of those workshops (meetings) and to take notes (transcriptions) of the dialogue that take place in that community between designers and users and (c) support the interchange of understandings, attitudes and ideas between the community and scientists. (in addition to SDWs).
(iv) Scientists maintain diaries to record in plain language their own socio-cultural awareness, and how (or whether) it develops as they work through the product design process. Where possible physical and design scientists keep a record of every technical and/or design decision they take, recording how they have come to that decision; what they considered in committing to a design; what they explicitly considered as possible social-cultural implications; and what the outcome of that consideration might be.

It is this integrated model of working which the paper intends to explore. Students from each university are concurrently undertaking activities linked with each case study, following the same co-design model of designers, engineers, physical scientists and human scientists. It is hoped that a model of best practice from this methodology can be developed which will assist future co-design projects and collaborative co-production of knowledge and cross-fertilisation between groups.

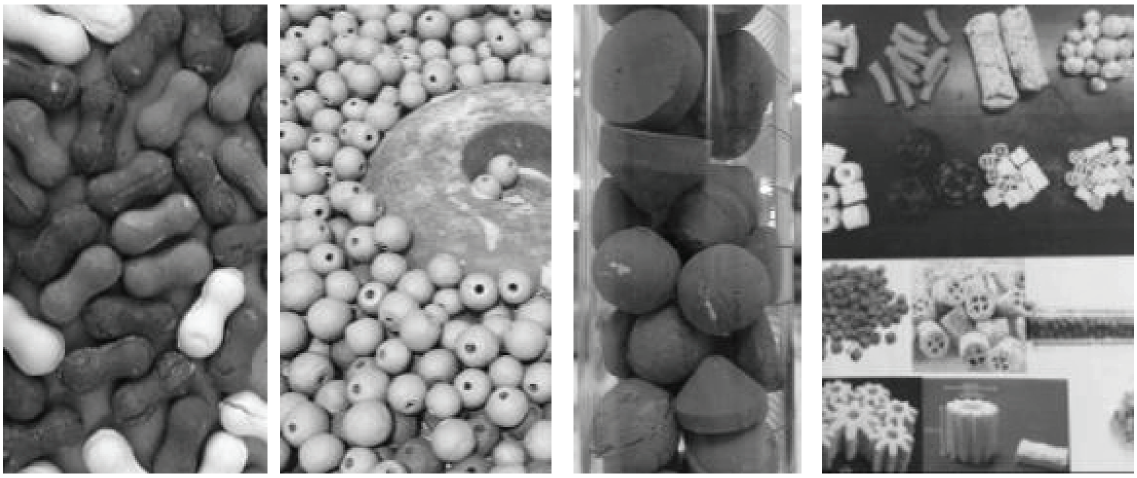
## 3 CASE STUDY – MALAWI CERAMIC WATER FILTER

Ceramic Water Filtration (CWF) is a household water treatment technique used in many developing countries. The mode of operation is that open source water is placed in an upper untreated water reservoir either incorporating or consisting entirely of a porous ceramic barrier which forms the filter. The water percolates through the filter, and the pores in the ceramic material are smaller than the dimensions of the microbial species and prevent biological pathogens from passing into the lower treated water container. Ceramic filters have been proved to remove turbid agents and the larger protozoan and bacterial organisms and viruses, and health impact assessments have reported 60-70% reduction of diarrhoeal disease incidence among users of high quality locally produced ceramic filters with safe storage in developing countries [3]. However, some bacteria can make their way through the ceramic barrier by deforming as they pass through the porous channels in the ceramic. Since ceramic filters rely on a relatively simple barrier method of separation, they can typically be expected to reduce bacterial populations to between 99%-99.9% of the starting value [4]. Ceramic filtration is most appropriate in areas with capacity for quality ceramic filter production, a distributed network for replacement of broken parts, and user training on how to maintain and use the filter [5]. Malawi fits this profile well, with local pot production shown in Figures 1, 2 & 3 and an established commercial ceramic industry. Many of the original contaminants are confined to the upper reservoir after treatment, so regular maintenance of the CWF is required by scrubbing the ceramic barrier with bleach to remove any biofilm that has become established. A major disadvantage of this requirement is that the brittle ceramic may become damaged and require replacement. Despite the limitations in efficacy and long term viability, CWF technology is widely accepted by communities in many developing countries. Part of the appeal of CWF is associated with a "technology bias" where the CWF has the appearance of a modern technology and there is social prestige associated with owning one and being able to provide treated water for family and guests.

*Figures 1-3. Local ceramic pot production, Chikwawa, Malawi*

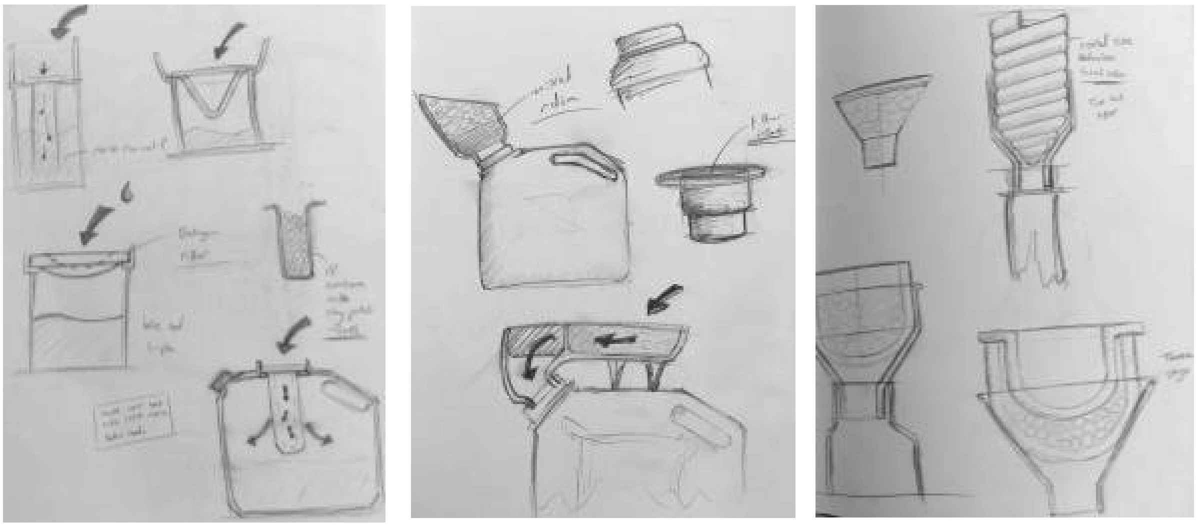
### 3.1 Design Thinking

Social science input [6] shows that acceptance of CWFs is high as they are simple to use and require only simple maintenance to clean the pot when the flow rate slows, their five year life span is long, and taste, smell and appearance of water are greatly improved. Initial discussions imply that user acceptance of CWF is high because it removes turbidity and other visible contaminants and improves taste. SODIS is proven to be effective at neutralising bacteria and viruses, a system that combines SODIS and CWF can maximize filtration of biological pathogens and user acceptance. A team of engineering students at UNIMA have defined the initial requirements for the ceramic filter element for use in a combined SODIS CWF system, and have examined the suitability of local clays for ceramic filtration. With SODIS to purify many of the bacterial and viral water contaminates, ceramic filtration requirements can be reduced. This allows flexibility in the filter form, allowing the team maximise flow rate and durability, which are shortcomings of current designs. The teams experimented with forms and clay types and additives to control flow rate, filter strength, and durability whilst maintaining robustness. Product Design students at Bucks concentrated on user requirements, acceptance and usability, at all times ensuring that the social science teams were informed and all dialogue and decisions were documented.



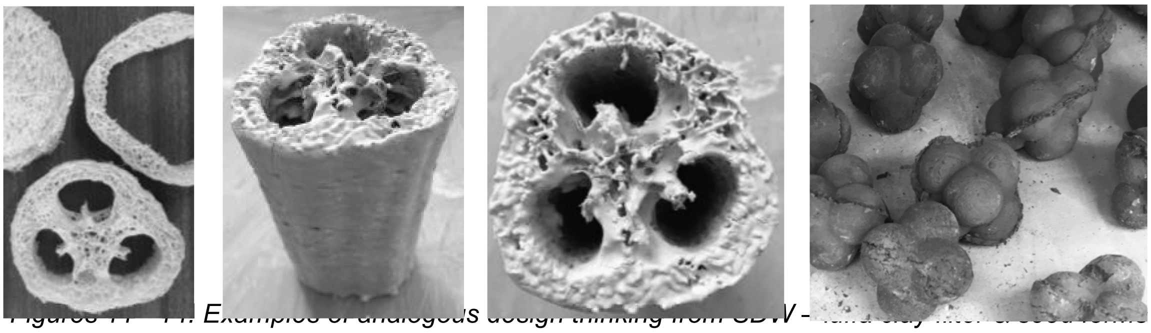
Figures 4-7. Ceramic filter modular units & geometries ideas for geometry

A combined design that requires users to perform SODIS before CWF risks users choosing only one step. It is important for the SDWs therefore to monitor perceived importance of each element in the combined system. Depending upon user preferences or beliefs, the system may need to be designed such that performing CWF is not possible without also performing SODIS. A SDW session was held to discuss placement options of the CWF directly on to a SODIS jerry can. The sessions were facilitated and designs visualised and documented by product design students at Bucks.



Figures 8-10. Designs for combined SODIS and CWF systems from SDW sessions

Various design tools were explored through the SDW and design sessions including analogous design thinking [7] and the SCAMPER technique (Substitute, Combine, Adapt, Magnify, Put to Other Uses, Eliminate, Rearrange) [8] which helped to encourage, engage and empower all of the participants in the design process. An example of this is shown in Figures 11-13 where a luffa and other naturally occurring forms were used as donors for making ceramic filter elements. Other natural forms such as peanuts, seeds, tubes, cones and spheres have been overwhelmingly most popular in these sessions.



*Figures 11 – 14. Examples of analogous design thinking from SDW - luffa clay filter & seed forms*

Teams at UNIMA mapped the problem of CWF design to identify the variables to control critical filter parameters such as flow rate, filtration, and durability. Innovation targets formulated from the mapping process were used to seed brainstorming sessions. This targeted brainstorming pulled from knowledge about specific additives, tools, and techniques for clay processing based on the interaction with SDW stakeholders. Problem mapping focused designer's attention on individual elements of the problem to develop an extensive solution set. The intersection of these solutions will be used to populate a mutually exclusive, collectively exhaustive (MECE) map, a tool for completing the solution set, and identifying combinations that best meet user needs, especially where many solutions exist [9].

### 3.2 Co-Design Thinking

Co-design is not new, there have been many studies on collaboratively designing services, products or processes [10]. Co-design indicates collective creativity as it is applied across the span of the design process, and refers to the creativity of designers and people not trained in design working together in the development process. Currently there is a large and growing emphasis on the front end of the design process, the pre-design, and it is at this stage where co-design has been applied. Frequently, ideas from this early creative stage are blended to create one good idea, so "1+1=3". It is important for facilitators to find appropriate methods for creative thinking and idea generation. While designers may prefer visual methods, others prefer verbal or written methods such as MECE and SCAMPER, a checklist utilising action verbs as stimuli to prompt creative ideas. It is clear from the SDWs that users and non-designers can produce creative outcomes that are effective, empathetic and insightful once working with appropriate tools in a collaborative environment. While stakeholder input is helpful to aid perception and acceptance, it can also formulate novel ideas that match existing paradigms of understanding about the problem. Designers fill a specific role in sculpting ideas, evaluating them, and supplementing ideas to formulate complete solutions; in this capacity, a structured approach can maximise the chance of success.

### 3.3 Lessons for design education

No one knows what the term *designer* means anymore [11]. It is evident from this project that the designer is more than just a facilitator for the co-design process. The cornerstones of sound design practice, analysis (define insights and form an understanding); ideation (generate concept solutions); empathy (understand user reality and context); prototype (build and to test for implementation), are still valid for current design education and practice. But successful design is not only about creative thinking. It also involves implementation and ensuring that ideas maintain their integrity. Designers must be involved over the duration of change processes, providing expertise and feedback to identify, test, and deliver durable solutions [12]. But what role is there for designers to play if future users are co-creating tangible visions of new products? Designers will be needed as they hold skills that are relevant at larger levels of scope and complexity. By selection and training, designers are good at visual thinking, conducting creative processes, finding missing information, and making decisions in the absence of complete information [13]. Designers must create and explore the potential of new generative design tools and bring the languages of co-design into their practice. Designers in the future will make tools for non-designers to use to express themselves creatively. Designers will need to play a role on co-designing teams as they provide expert knowledge lacking in other stakeholders. Designers explore and keep track of new, existing and emerging technologies, and have an overview of production processes and emerging social and business contexts, and design educators must strive to instil this in their students.

*Figures 15-17. Renders of final ceramic filter design for initial tests in Malawi*

## 4 CONCLUSION

There is a long, rich tradition of social sector participatory engagement. What is new is the attempt to formalise process and highlight the importance of participants, producing universal rules of engagement in co-design such as "involve users and stakeholders early" and "assume their ideas are better". The true effectiveness of these co-design processes remains largely unproven when used in interdisciplinary projects. To help better understand how and why we should co-design, further research needs to happen in conjunction with stakeholders. WATERSPOUTT provides an opportunity for users to work with service providers and stakeholders to co-design and develop better products, services, and technologies. Involving and engaging people to design, develop and deliver creates better solutions and results in greater, meaningful social impact. Co-design of community based solutions is challenging but it may develop new domains of collective creativity, requiring new tools and methods for research and design. We should provide curricula to help students design in the new front-end development and creative generation processes. We should ensure that we support and nurture the collective creativity of others, and have effective methods to evaluate, report and communicate the impact of co-design. This ongoing four year project should provide the transdisciplinary opportunity to demonstrate this effectiveness.

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