# A Comparison of Two Transdisciplinary Human-Centered Design Approaches for Poverty Alleviation

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**Abstract.** This descriptive study characterizes two transdisciplinary human-centered design approaches for creating novel products or services for poverty alleviation. *Transdisciplinary design* involves the integration of skills or knowledge from multiple disciplines in one holistic process. The term *discipline* includes academic fields of study that are taught in universities, as well as specialized expertise that are developed through life experience. Two pioneering organizations were selected to be exemplary case studies based on their high regard and influence within the design industry, social sector, and academia. This paper highlights similarities and differences between the design thinking approach practiced by IDEO.org (a nonprofit design consultancy) and the Creative Capacity Building approach developed by the International Development Design Summit (an educational organization hosting annual innovation conferences). IDEO.org's teams of professionals (e.g., industrial designers or business strategists) develop innovative products and services for implementation by partners serving low-income communities. IDDS teaches people from all walks of life (e.g., villagers, mechanics, students, teachers, doctors, economists, priests, masons, and artists) to create technologies and launch enterprises for poverty alleviation. IDDS believes this intentional eclecticism is at the heart of innovation, and that exposing non-designers to design expands capabilities for general problem solving. The objective is not to determine which approach is better, but to determine what can be learned from IDEO.org about designing with established organizations, and from IDDS about teaching budding innovators to be grassroots change agents.

**Keywords:** human-centered design, design thinking, Creative Capacity Building, participatory development, co-creation, co-design, appropriate technology

## 1 Introduction

Socioeconomic development projects are typically designed by experts from a single discipline without involving people who are the intended users of the solution. However, this approach often results in ineffective solutions that neglect social factors, such as cultural preferences or behavior change. With human-centered design (HCD),

design decisions are guided by the needs of potential *users* or people whose experiences will be transformed by the design [1, 2]. HCD is especially important when designers come from a different cultural and socioeconomic background than their intended users. Moreover, the multidimensional nature of sustainable development requires the expertise of many disciplines, thereby making transdisciplinary design not only an asset but a necessity [3, 4]. Rather than members of different disciplines working with separate processes, *transdisciplinary design* involves the integration of skills or knowledge from multiple disciplines in one holistic process to create a novel product, service, or system meeting a complex societal need [5, 6]. The term *discipline* includes academic fields of study, as well as specialized expertise from life experience. Scholz asserts that knowledge that is intuitive and experiential is just as valid as knowledge that is analytic and abstract [5]. For example, farmers and agricultural engineers possess different yet relevant spheres of knowledge related to agriculture. Furthermore, when working across cultural boundaries, knowledge of local language, customs, and social norms should be recognized as expertise.

As HCD is an emerging practice in the social sector, a critical first step is a descriptive study. This paper characterizes two HCD approaches to address challenges in low-income communities. Two pioneering organizations were selected to be exemplary case studies based on their high regard and influence within the design industry, social sector, and academia. This paper compares the design thinking approach practiced by IDEO.org and the Creative Capacity Building (CCB) approach developed by the International Development Design Summit (IDDS).

### 1.1 Pioneering Organizations in HCD for Social Impact

IDEO, the award-winning global design firm, is widely renowned for popularizing design thinking. Design thinking is considered to be "potentially universal in scope, because design thinking may be applied to any area of human experience" [7]. In 2011, two former leaders of IDEO's Social Innovation Domain founded IDEO.org as an independent nonprofit organization that works with partner organizations (nonprofits, social enterprises, and foundations) to design for poverty alleviation. Every year, IDEO.org recruits a new Fellowship class of IDEO designers and social sector leaders. IDEO.org's recruitment criteria is somewhat influenced by IDEO's concept of a "T-shaped" profile, represented by a disciplinary depth of skill to make tangible contributions to the team as well as "empathy towards people and disciplines beyond one's own" [8]. At IDEO.org, transdisciplinarity is represented by a diversity of professional disciplines including industrial design, business strategy, engineering, social marketing, journalism, and information design. In 2011, each of the three IDEO designers led a team of two to three other Fellows working on 6-week to 12-week design projects. Fellows were assigned to teams based on the expertise required to produce the best deliverable for each project. To ensure high-quality design, IDEO creative directors reviewed progress at critical milestones.

The International Development Design Summit (IDDS) was founded in 2007 at MIT, and has been recognized by USAID as a model of excellence for engineering education. For IDDS, transdisciplinarity goes beyond academic disciplines to include

expertise from trade skills or life experiences. IDDS is an annual 3- to 5-week conference that uses the Creative Capacity Building (CCB) approach to inspire and enable people with a range of expertise (e.g., mechanics, students, teachers, doctors, economists, priests, masons, and artists) to create technologies for poverty alleviation.

With roots in the appropriate technology movement and participatory development, CCB is based on the premise that *anyone* can become an active creator of technology, not just a recipient or user of technology [9]. IDDS brings together over 60 people from more than 20 countries worldwide to form design teams and innovate livelihood technologies that "increase income, improve health and safety, decrease manual labor or save time" [9]. These IDDS participants learn the design process through lectures and hands-on workshops, and apply these principles and skills on team projects. Each team is assigned a mentor who guides the team based on extensive experience in design or entrepreneurship. IDDS design teams are formed based on the participants' project preferences. IDDS strives for diversity in teams, so teammates may speak different languages, and have different socioeconomic and disciplinary backgrounds.

### 1.2 Methods and Study Projects

This descriptive study is a qualitative analysis of documents, in-person project observations, and informal conversations. The lead author worked as an IDEO.org Fellow between September 2011 and May 2012, and served various roles as an organizer, participant, and team mentor for IDDS in 2007, 2008, 2009, 2010, and 2012. Working on design teams on four projects with IDEO.org and five projects with IDDS enabled the lead author to have the perspective of an embedded researcher [10]. The projects include work in water, sanitation, and alternative energy in Africa and Asia. The deliverables include early functional prototypes, business models, and a brand strategy.

## 2. The Design Process

Most design processes are linear, iterative, and include the core stages of establishing a need, analysis of a task, conceptual design, embodiment design, detailed design, and implementation [4]. CCB and design thinking include these core activities, and also adds "gathering information from users" [9], which is integral to HCD approaches. Both frameworks view the design cycle as a process of iterative refinement with more detail, depth, and understanding gained with each iteration. Although most design processes are linear [4], CCB is represented as a cycle [9] and design thinking is represented as a system of overlapping spaces (Inspiration, Ideation, and Implementation) [8]. One can "think of inspiration as the problem or opportunity that motivates the search for solutions; ideation as the process of generating, developing, and testing ideas; and implementation as the path that leads from the project stage into people's lives" [8]. A design thinking team may be in two or three spaces simultaneously, and the transition through these spaces is not necessarily sequential [11].

Contrary to multidisciplinarity, in which each expert in the group may be advocating for his own opinion or process, transdisciplinarity promotes a collective owner-

ship of ideas [12]. Unlike other design approaches in which each discipline serves a unique role, in design thinking and CCB, teams overlap in activities with each individual stretching beyond his expertise to contribute in *all* phases of the design process. For example, instead of an ethnographer interviewing the user and giving insights to a designer who then creates a product, all team members would conduct interviews and create an integrated solution together.

### 2.1 The Project Brief

A design project typically begins with a brief that establishes realistic goals with opportunities to explore and discover unexpected and serendipitous solutions. IDEO.org's leadership works with partners to carefully craft a brief that will maximize the impact of the design team for the partner's goals. Since IDEO.org aims to have measurable impact, projects tend to focus on products or services rather than strategy.

IDDS projects are proposed by IDDS' network of development workers, lecturers, or participants. Although global applicability is a long-term goal, IDDS projects initially focus at the community level with partnerships in city neighborhoods or villages. Projects have been selected based on various criteria including the design team's interests, the potential for innovation and scalability, proposals by a founder who has committed to launching a venture, or the needs of partner communities. Project types have included fundamental scientific research, adapting an existing technology for low-cost production in developing countries, and adapting crop-processing equipment for alternative power inputs.

Notably, design thinking and CCB both leave flexibility for design teams to change the project scope. This reframing of the problem is critical for innovation. For example, an IDDS brief initially focused on designing a device that heats and disinfects breast milk containing HIV. The team redefined the problem as preventing mother-to-child transmission of HIV, and developed a novel concept to chemically deactivate the HIV in breast milk as it passes through a nipple shield. The team received funding from the Gates foundation to research this promising idea. The new problem framing enabled the team to explore an entirely new design space, leading to an innovation that is potentially cheaper, easier to distribute, and more discreet for mothers to use.

### 2.2 Inspiration

In the inspiration space, the team gathers information that will improve understanding of the problem and possible solutions. Before starting user research in the field, IDEO.org and IDDS design teams conduct secondary research online about the current situation, competitors, and analogous inspirations from other fields.

IDEO.org design teams may receive information and guidance from partners or IDEO designers who have worked on similar projects. IDEO.org's and IDEO's vast professional network also gives the design team access to experts from various sectors. Since most of IDEO.org's projects focus at the regional or national scale, user research is typically conducted in multiple locations to gain a broader understanding of trends beyond a single village or neighborhood. Often the design team will create a

research plan including a rough schedule, methods (e.g., shadowing or semi-structured interviews), user profiles, and interview questions. The team may also create artifacts, photo prompts, or other props that would help a user imagine a scenario. IDEO.org's local contacts or partners may help organize site visits or user interviews. Sometimes, IDEO.org hires a local market research agency to identify potential users and may also compensate them for their participation. Implementation partners are encouraged to accompany the design team during the user research so they may hear needs directly from users. To gain credibility quickly and facilitate understanding, IDEO.org works with local partners who serve as translators, cultural guides, and community liaisons [8]. IDEO's HCD Toolkit includes methods (e.g., self-documentation through photos) to help users express what may be tacit knowledge, or that which is implicit or inherently understood but difficult to verbalize [13].

For IDEO.org, the needs of their implementation partners and users guide design decisions but they are generally not part of the core design team. Some transdisciplinary design approaches assume that full participation by users is ideal [14, 15]. However, this paper suggests that the organization and project goals dictate whether it is appropriate to involve users and the extent of participation. For a project designing a brand for a dignified sanitation service, an IDEO.org design team interviewed employees and users to understand what emotional meaning was associated with the service. Since marketing and graphic design are beyond the skill set of an average person, teaching these skills to enable full participation would have required additional resources. In this project, users were appropriately consulted, and the users' values of reliability, comfort, and pride became core service principles [16].

For IDDS, user research involves a general needs assessment of a village or urban neighborhood to understand the context of users' lives beyond the project. IDDS teams live in the communities they work in for periods of a few days to weeks and often participate in many of their users' daily activities. There is a rapport and trust that develops during this time that is difficult to reproduce in a short interview setting. IDDS teams also gather information through observations and interviews.

Community members from the locales where IDDS works are specifically encouraged to participate in IDDS, and serve as cultural guides and liaisons to the community. Volunteer translators enable community members on the design team to fully engage in the design process. It is important to note that although community members can contribute relevant knowledge about the context of use and the intended user, they may not be users themselves. IDDS recognizes that no individual can represent the needs of everyone in his community. Although community members' contextual knowledge and practical expertise are valued, IDDS teaches all participants to question their assumptions and to gather feedback from actual users.

### 2.3 Ideation

During Ideation, design teams generate many concepts, prototype to learn, and select the most promising concepts to implement. Especially for transdisciplinary design teams in which disciplinary terminology may differ widely, *intermediary objects* (representations that are created or manipulated to support integration of knowledge) are

crucial for developing a common understanding of the design problem and proposed solutions [17]. Since IDEO.org designs strategies or services in addition to products, the intermediary object may range from abstract constructs to tangible prototypes. The intermediary object for IDDS is typically a tangible prototype. IDEO.org has dedicated project spaces where everyone can access the same intermediary objects and interact real-time with them. Synthesis is the process by which design thinkers distill what they observe into insights that can lead to opportunities for change or solutions. Design teams often capture important themes from user research with sticky notes because the limited size encourages conciseness, and the colors and mobility enable rapid categorization and pattern recognition. Brainstorming is a popular method for generating many ideas, which are evaluated through design reviews with feedback from IDEO.org's leadership, clients, or users. Often, rather than choosing one idea over another, the promising elements of various ideas are combined.

Since industrial design is one of the core disciplines at IDEO.org, visual thinking is naturally encouraged. Drawing forces decisions, and captures emotional content as well as functional characteristics [12]. Sketching has also been shown to enable insights and the co-evolution of the design problem and possible solutions [18]. User experiences are prototyped with visualizations or narratives (e.g., personas or storyboards). Physical prototypes may also be fabricated with increasing refinement from sketch modeling materials (foam core, hot glue, etc.) to 3D printed or machined parts.

IDDS teams do not work in a dedicated project space, but they share workshops with other teams, which facilitates cross-pollination of ideas and collaboration across projects. IDDS teams discuss insights and ideas verbally, but written communication may be difficult for teams managing multiple languages and varying levels of literacy. IDDS teams learn to convert user needs into design requirements (e.g., speed, power, cost, etc.) that can be measured and tested with simple experiments. Teams brainstorm ideas and evaluate their concepts against those metrics with Pugh Charts. Learning to use basic hand tools and building a simple functional device (e.g., water pump, solar lantern, etc.) are core components of the CCB curriculum. Found or recycled materials or inexpensive parts like PVC pipes and steel stock are commonly used for prototyping. Building physical prototypes with simple tools and materials facilitate communication and shared understanding across disciplines and cultures.

### 2.4 Implementation

During Implementation, ideas move towards realization. As consultants, IDEO.org's impact upon end users is dependent upon whether partners decide to implement the concepts. Consequently, conveying a plausible story of a compelling need and solution to the client is critical. Sometimes, this story itself is the deliverable and the tangible product may be a "slide deck" presentation, which contains insights evoking empathy for users and inspiring ideas for clients. Stories, user profiles, quotes, and pictures are commonly used to convey research findings within an "Insights and Opportunities" framework. Prototypes may be conceptual ideas or looks-like renderings that are meant to capture the imagination. Sometimes, detailed artifacts (e.g., a financial model, customer journey, sample advertisement) serve as examples of how a

concept may come to life. However, regardless of how promising a concept is or how well its value and actionability are communicated, partners may decide not to implement. The project may no longer be a priority to the organization due to a shift in strategy, change in leadership, or budget constraints. Despite these challenges, 50% of the projects from IDEO.org's first year are being implemented.

For IDDS, implementation refers to refinement of a physical prototype, fabrication, testing and evaluation, and gathering user feedback. IDDS ends with a final presentation at a public event at which community stakeholders are invited to give feedback on the teams' prototypes. Since IDDS focuses upon engineering design and innovating early-stage technologies, most teams produce a functional prototype but have not yet refined the business model or dissemination plan. Although it may take years for the prototypes to become products ready for market, IDDS' connection to academic research institutions provides a means for work to continue beyond the conference. Since there is usually no client or funder for the project, IDDS helps participants raise funds, recruit new team members, form partnerships with implementers, or found new ventures. Some participants return to IDDS with new project ideas or to further work on a previous IDDS project. IDDS' annual conferences build a diverse global network of designers who support one another in innovation and entrepreneurship.

An impact assessment of IDDS is planned to start in September 2013. Preliminary hypotheses and anecdotal evidence suggest that the intentional eclecticism of IDDS may be critical for innovation and transformative for participants and their communities. The democratic and participatory ethos of IDDS challenges societal hierarchies that typically hinder interactions between members of different social groups. For example, despite their limited formal education, artisans (e.g., welders, carpenters, mechanics, etc.) may demonstrate their innate ingenuity and teach fabrication skills to academics and professionals. Moreover, exposing people outside the realm of design, to the design process expands their capabilities and changes their view of their self-efficacy and agency. For example, after IDDS, a Tanzanian bicycle mechanic invented a solar-water heater and pedal-powered drill presses, blenders, and hacksaws. He and several other IDDS participants have also started design education programs and technology innovation centers in their communities. IDDS is especially transformative for female participants since gender roles in some cultures associate technology with masculinity. In addition to women realizing their ability to create and use technologies, some IDDS technologies (e.g., grain threshers and mills) have the potential to shift the division of labor from women's manual labor to men's automated tasks.

## 3 Analysis of Project Case Studies

Twelve projects were completed in IDEO.org's 2011 Fellowship year. Fifty-six projects were completed by IDDS between 2007 and 2012. Four IDEO.org projects and five IDDS projects from this time period were analyzed based on various project features, and insights were drawn from this comparison. As an example of the project analyses, Table 1 compares two projects tackling the challenge of providing clean water to low-income communities.

**Table 1.** Comparison of design thinking and CCB as applied to two water projects

| | IDEO.org - SmartLife | IDDS - Zimba |
|---|---|---|
| **Project Brief** | Design a scalable *business* to sell water alongside nutrition and hygiene products to urban Kenyans | Design a *device* to automatically add the appropriate dose of chlorine to water as it flows out of hand pumps |
| **Motivation** | Create new sales channels and multiply health benefits for users by integrating water, nutrition, and hygiene | A personal mission of an Indian inventor to improve the lives of the poor through innovative technologies |
| **Design Team** | Architect, business strategist, and engineer led by an industrial designer | Engineering students led by a community member |
| **User Research** | Semi-structured interviews with 28 customers, 13 entrepreneurs, and 1 government agency. A local market research firm in Nairobi, Kenya set up interviews based on user profiles. | Inventor's prior experience installing hand pumps in villages provided insights for context of use. The team visited villages to conduct informal tests, interviews, and observations. |
| **Prototyping** | Translators role-played as SmartLife employees and sold branded water and health products to customers. | Functional prototypes were made using fiberglass, simple hand tools, glue, and plastic sheets and tubes. |
| **Intermediary Objects** | Storyboards, brand identity, financial analysis spreadsheets | Physical prototypes, CAD models, business plans |

IDEO.org partnered with Unilever, Water and Sanitation for the Urban Poor (WSUP), and the Global Alliance for Improved Nutrition (GAIN) to design a scalable business selling clean water along with hygiene and nutrition products [19]. During two weeks of fieldwork in Nairobi, the design team conducted 50 interviews and set up a mock business and fake brand, selling 520 liters of water in two days [19]. They tested several touch points in isolation and designed a business model including retail locations, a delivery service, and door-to-door sales representatives [19]. The resulting SmartLife brand highlights the convenience and reliability of the service rather than the traditional focus on health that most water initiatives emphasize. The design team proposed a pilot testing two concepts: Aspirational Wellness (drinking water with carefully curated personal care products) and Everyday Essentials (all-purpose water with familiar household and hygiene products) [19]. The first SmartLife kiosk opened in February 2013 in Kenya with plans to obtain 500 families as customers within their first next six to nine months [20].

At the 2009 IDDS in Ghana, an inventor from Kolkata, India proposed a project to design a device to automatically chlorinate water in villages. Chlorine is affordable, readily available, and effective for treating most waterborne pathogens, however the education and behavior change required to properly use chlorine for water treatment have been barriers to adoption. The IDDS Doser team designed and prototyped a device that would accept intermittent and variable water flow and dispense an appropriate amount of chlorine into the water. The Doser team recruited UC Berkeley and MIT students to continue the research and was awarded a $20,000 research grant from the National Collegiate Inventors and Innovators' Alliance. In 2013, Zimba was founded as a for-profit company with a patent pending for the chlorine doser. Zimba partnered with NGOs, research centers, and universities for pilots in India and Bang-

ladesh. During a one-year pilot, 2 million liters of water were purified by two Zimba chlorine dosers at a cost of five rupees or $0.10 per 10,000 liters of water [21].

Both SmartLife and Zimba reached new customers with new offerings providing safe water. For SmartLife, the business was the enabler, whereas for Zimba, technology was the enabler. SmartLife's innovation is a high-touch subscription service providing low-income customers with the reliable delivery of clean water and health products. Rather than inventing new technologies, SmartLife operates with existing technologies. In contrast, Zimba's innovation is a device that minimizes behavior change and offers robust functionality in resource-constrained environments. The Zimba doser makes automatic chlorination affordable for individuals, households, and communities for diverse situations (e.g., chlorination at the point of collection, in homes, or at water kiosks and food stalls) without electricity or piped water.

Although it is beyond the scope of this paper to assess effectiveness or impact, some differences between SmartLife and Zimba are indicative of the different operational models of IDEO.org and IDDS. SmartLife was able to progress from concept to pilot in less than a year whereas Zimba moved from concept to pilot in about three years. However, SmartLife's budget was at least ten times more than Zimba's. SmartLife also had the advantage of several full-time salaried and experienced professionals working for established organizations with proven success. Zimba's staff consisted mostly of part-time student volunteers or recent graduates who had limited or no experience launching a product or business. The different trajectories of these projects are somewhat due to the differences between the operational models of professionals consulting for established organizations as compared to entrepreneurship and invention driven by budding innovators.

## 4 Discussion and Future Research

Both organizations are continually evolving. For example, IDEO.org initially planned to train an entirely new cohort of Fellows each year rather than having design team members as permanent staff. However, to enhance organizational learning and continuity, one of the 2011 Fellows continued with IDEO.org as a permanent Project Lead. In 2013, IDEO.org also created a full-time position for an Interaction Designer.

IDDS also revises its curriculum every year. When the conference location moved from MIT to Ghana in 2009, IDDS added lectures on Ghanaian culture and user research to prepare design teams to conduct interviews and observations with users in partner villages. IDDS also developed hands-on "Build-It modules," in which IDDS participants learned prototyping skills by making various technologies. For example, participants learned about basic electronics and hand tools by making a solar lantern. In 2010, IDDS shifted focus from creating early stage technologies to advancing prototypes to products and projects to ventures, and new lectures were created to teach business plan design, manufacturing at different scales, and supply chains management. In 2012, IDDS was held in Brazil, where lectures were bilingual with real-time translation between Portuguese and English. This was also the first IDDS to offer projects for urban areas in addition to the typical focus on projects for villages.

In summary, IDEO.org and IDDS have the same fundamental goal of design for poverty alleviation but there are significant differences in their approaches, as shown

in Table 2. Aiming for measurable impact, IDEO.org tends to focus on products or services for partners who have already achieved some influence or scale. With the goal of building design capacity, IDDS inspires and teaches people from a wide range of educational, occupational, or social statuses to invent technologies and launch ventures in villages and urban neighborhoods. The imperative for future research is not to evaluate which approach is better, but to determine what can be learned from each.

**Table 2.** Comparison of IDEO.org and the International Development Design Summit

| | **IDEO.org** | **IDDS** |
|---|---|---|
| **Approach** | Design Thinking | Creative Capacity Building |
| **Operation Model** | Partners pay a fee for service to IDEO.org for 6 to 12 week design consulting projects. | Donors fund annual 3 to 5 week conferences teaching design with lectures, hand-on activities, and team projects. |
| **Mission** | 1. Increase the impact of partner organizations through design<br>2. Train social sector leaders in design thinking<br>3. Create resources to share HCD methods and processes online | 1. Develop early-stage appropriate technologies<br>2. Create a global innovation network of entrepreneurs and inventors<br>3. Increase capacity for technology creation in developing countries |
| **Design Team** | Professionals in industrial design, business strategy, engineering, journalism, and information design | Potential change agents (e.g., villagers, mechanics, students, teachers, doctors, farmers, masons, priests, and artists) |
| **Scale** | National or global | Villages and urban neighborhoods |
| **Deliverable** | Business models, brands, products, experiences, services, strategies | Appropriate technologies that can be operated and maintained locally |
| **Strength** | Emotional meaning | Elegant functionality |
| **Strategies for Impact** | Storytelling and high-quality design inspire partners to implement. | IDDS participants build prototypes, develop products, and launch ventures. |

This paper has mainly focused on the similarities and differences between IDEO.org's design thinking and IDDS' CCB as transdisciplinary human-centered design (HCD) approaches for poverty alleviation. However, perhaps what are more pertinent are the emerging patterns of the influence of "HCD for poverty alleviation" on innovation, on development practitioners and users, and on design education.

Designing for the resource-constraints environments of low-income communities may expand the forefronts of innovation and generate solutions applicable for our over-consuming society. Constraints force designers to strive towards more *elegant* (cleverly simple and unusually effective) solutions that use appropriate resources more efficiently. For example, since the Zimba doser must function off-grid, the Zimba doser works on gravity and does not require any fuel or electricity. Since hinges, levers, and valves often wear out and need replacement, the Zimba doser was designed with no moving parts to ensure robustness, especially in remote areas where parts and supplies are scarce. This simplicity minimizes costs and enables the Zimba doser to be produced and maintained with materials and manufacturing processes that are commonly available in developing countries. Moreover, the Zimba doser's ability to accurately and consistently measure and mix fluids may be applicable for purposes

other than water treatment. Shawn Frayne – founder of Haddock invention and member of the IDDS network – refers to *confluent technologies* as innovations that emerge out of the scarcity and extreme pressures of low-resource areas to leapfrog over incremental or wasteful technologies in developed regions [22].

Transdisciplinary design incorporates some components of systems thinking to create holistic solutions that address the system rather than isolated aspects of the challenge. Transdisciplinary design extends the boundaries of the design space beyond focusing on economic or technological factors, to consider the socio-political, cultural, environmental, and ethical implications, thereby increasing the likelihood that a solution will be adopted and sustained effectively [23]. For example, in designing the SmartLife business model, the IDEO.org design team considered both the "micro and macro elements of the entire ecosystem […], including the customer experience, the business model, the financial breakdown, and the brand expression" [24]. The design team "constantly zoomed in and zoomed out, making sure that the pieces make sense both individually and working together" [24].

Exposure to the design process as a structured way of framing a problem, generating innovative concepts, and refining and implementing a solution may empower development practitioners and low-income communities by encouraging people to try new ideas, experiment iteratively, and effect change. "CCB postulates that technology creation can be one pathway for an individual to identify or affirm their own abilities, to invite communities to seek solutions together, and to build towards meaningful influence over their lives and livelihoods" [9]. A preliminary evaluation of three-day CCB workshops conducted in Pader, Uganda suggests that CCB may encourage communities to work collaboratively "to develop technologies to meet their needs and/or generate income" and that individuals felt more "empowered to produce, repair, and adapt things" [9]. In fact, within a month of a CCB workshop in Pader, Uganda, community members had created 13 technologies, including a pedal-powered knife-sharpener, a wooden cart, and storage pots for evaporative cooling [9].

Integrating transdisciplinary design into high school and undergraduate curricula could empower a new generation of design thinkers to address the complex societal challenges of the future. Teaching a general creative problem-solving approach that focuses on understanding people and their needs could provide a broadly applicable framework that promotes critical thinking and the integration of knowledge across multiple disciplines [6]. Project-based service learning courses have also been shown "to improve retention, student satisfaction, diversity, and student learning" [2].

As transdisciplinary human-centered design (HCD) gains prominence for innovating solutions for poverty alleviation, it will be increasingly important to conduct more in-depth studies on its utility for innovation, the adoption of resulting solutions, the impact on those exposed to the design process, and implications for design education.

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