Collaborative Effect-Centered Problem-Solving

Moritz Hartstang, Jürgen Held

Introduction

In design studies, researchers have repeatedly tried to use the separation from other disciplines to establish the individuality of design. There is a conviction that design as a discipline has an individual "rigorous" and "intellectual culture" and should focus on itself without being influenced by the cultures of other disciplines.[1] We argue that this separation of disciplines does not correspond to reality and restricts the individuality of people and the development of disciplines.

What are the individual abilities of designers? Nigel Cross defined five aspects of designerly ways of knowing: individual "solution-focused" solving of specific "ill-defined problems," individual creativity with "constructive" thinking, and use of codes translating "abstract requirements into concrete objects […] to both read and write in object languages"[2] The conviction above and this definition lead to the prevailing design-centered understanding and execution of problem-solving. We argue that this centrality currently prevents problems from being solved and continues to create new problems.

Along with separation, there is the perception that the individuality of design can influence many other disciplines. For example, designers should disseminate their individual knowledge and methods to benefit other disciplines.[3] Design can also integrate knowledge in companies, and teaching design to managers is becoming increasingly important.[4] The application and recognition of design are rising in other disciplines and society, and individual abilities like design thinking could even be part of decision-making in social life.[5]

To establish the individuality of design through separation, researchers often compare design to other disciplines. They portray the discipline as a person with individual knowledge, abilities, and tasks and ask themselves who it would be related to. For example, researchers have discussed whether science and design are "relatives, perhaps even siblings" or "teleological family and methodological identical twins."[6] Not only are the people's relationships considered, but so is how their family tree is structured. Here, opinions differ widely. Design can be justifiably argued as the "basis of engineering," "inextricably bound up with

1 Nigel Cross, "Forty Years of Design Research," *Design Studies* 28, no. 1 (2007): 1–4, https://doi.org/10.1016/j.destud.2006.11.004; Nigel Cross, "Designerly Ways of Knowing: Design Discipline versus Design Science," *Design Issues* 17, no. 3 (Summer 2001): 49–55, https://doi.org/10.1162/074793601750357196.

2 Nigel Cross, "Designerly Ways of Knowing," *Design Studies* 3, no. 4 (1982): 221–27, https://doi.org/10.1016/0142-694X(82)90040-0.

3 Kees Dorst and Lambèr Royakkers, "The Design Analogy: A Model for Moral Problem Solving," *Design Studies* 27, no. 6 (2006): 633–56, https://doi.org/10.1016/j.destud.2006.05.002.

4 Per Åman, Hans Andersson, and Mike Hobday, "The Scope of Design Knowledge: Integrating the Technically Rational and Human-Centered Dimensions," *Design Issues* 33, no. 2 (Spring 2017): 58–69, https://doi.org/10.1162/DESI_a_00439; Peter Gorb, "The Business of Design Management," *Design Studies* 7, no. 2 (1986): 106–10, https://doi.org/10.1016/0142-694X(86)90023-2.

5 Marzia Mortati, "A Framework for Design Innovation: Present and Future Discussions," *Design Issues* 31, no. 4 (Autumn 2015): 4–16, https://doi.org/10.1162/DESI_a_00347; Wolfgang Jonas, "A Scenario for Design," *Design Issues* 17, no. 2 (Spring 2001): 64–80, https://doi.org/10.1162/07479360152383796.

6 Per Galle and Peter Kroes, "Science and Design: Identical Twins?," *Design Studies* 35, no. 3 (2014): 201–31, https://doi.org/10.1016/j.destud.2013.12.002; Robert Farrell and Cliff Hooker, "Designing and Sciencing: Response to Galle and Kroes," *Design Studies* 37 (2015): 1–11, https://doi.org/10.1016/j.destud.2014.12.003.

https://doi.org/10.1162/desi_a_00768

the idea of science," "only one facet of technological activity," and the amalgamation of "multiple incommensurate sciences."[7] In considering the comparison of different disciplines, the knowledge, abilities, and tasks attributed to design are arguably integrated in other disciplines. It can even be argued that scientists also design.[8] Still, the knowledge, abilities, and tasks attributed to other disciplines are also integrated into design. Design can, for example, be seen as "both scientific and technological."[9]

How can a discipline simultaneously compare itself with others, separate itself from them, and integrate itself into them? What then remains of the individuality of design? We argue that the disciplines should not be considered as individual people, but the individual people in the disciplines should be considered. Every person has knowledge, abilities, and tasks that can be attributed to several disciplines. The individuality of a discipline is therefore variable and depends on which people interact with one another. Defining the individuality of a discipline limits the individuality of the people and the development of the discipline. To benefit from the individual knowledge, best abilities, and creativity of many different people, we argue the need for a collaborative rather than a design-centered understanding and execution of problem-solving. To achieve that, more people, regardless of their prior knowledge and discipline, need the ability to identify and understand relevant problems and solution approaches in different areas to develop solution concepts creatively and collaboratively. Therefore, the newly developed effect method is introduced; by researching defined interrelations between subjects (terms considered as single entities) and systems (terms considered as multipart entities), this method empowers people to identify and understand relevant problems and solution approaches. The effect method enables the development of system-compatible solution concepts. As a result, each person's knowledge, best abilities, and creativity can contribute to the collaborative development of relevant solutions.

Individuality through Collaboration Instead of Separation

The attempt to establish the individuality of design through separation from other disciplines fails because the definition of design is variable, and the word "design" is used as a variable. Furthermore, by "lacking a formal structure," design is open to different terminology, which hinders the identification of specific design knowledge.[10] The attempts at parent definitions—from "courses of action aimed at changing existing situations into preferred ones" to "the selection of an advantageous synthesis of 'ends' and 'means'" do not go beyond generalities.[11] Apart from that, it is often argued that specific problems define design but the knowledge of many other disciplines can be incorporated to solve these problems.[12] Furthermore, it can be argued that

7 Douglas Lewin, "On the Place of Design in Engineering," *Design Studies* 1, no. 2 (1979): 113–17, https://doi.org/10.1016/0142-694X(79)90008-5; Michael Batty, "Limits to Prediction in Science and Design Science," *Design Studies* 1, no. 3 (1980): 153–59, https://doi.org/10.1016/0142-694X(80)90022-8; S. A. Gregory, "Design as Part of a Job," *Design Studies* 3, no. 2 (1982): 65–76, https://doi.org/10.1016/0142-694X(82)90051-5; Philip Sargent, "Design Science or Nonscience," *Design Studies* 15, no. 4 (1994): 389–402, https://doi.org/10.1016/0142-694X(94)90003-5.

8 Gui Bonsiepe, "Design and Democracy," *Design Issues* 22, no. 2 (Spring 2006): 27–34, https://doi.org/10.1162/desi.2006.22.2.27.

9 R. Levy, "Science, Technology and Design," *Design Studies* 6, no. 2 (1985): 66–72, https://doi.org/10.1016/0142-694X(85)90016-X.

10 Sharon Poggenpohl, Praima Chayutsahakij, and Chujit Jeamsinkul, "Language Definition and Its Role in Developing a Design Discourse," *Design Studies* 25, no. 6 (2004): 579–605, https://doi.org/10.1016/j.destud.2004.02.002.

11 Herbert Alexander Simon, *The Sciences of the Artificial* (Cambridge, MA: MIT Press, 1978); G. G. Scarrott, "Organization of Design and Development," *Design Studies* 2, no. 4 (1981): 229–33, https://doi.org/10.1016/0142-694X(81)90055-7.

12 William Fawcett, "A Note on the Logic of Design," *Design Studies* 8, no. 2 (1987): 82–87, https://doi.org/10.1016/0142-694X(87)90005-6.

13 Raymond A. Willem, "Varieties of Design," *Design Studies* 12, no. 3 (1991): 132–36, https://doi.org/10.1016/0142-694X(91)90021-N; Nigel Cross, "The Nature and Nurture of Design Ability," *Design Studies* 11, no. 3 (1990): 127–40, https://doi.org/10.1016/0142-694X(90)90002-T; Nigel Cross, "Design Expertise," *Design Studies* 31, no. 2 (2010): 203–5, https://doi.org/10.1016/j.destud.2009.12.001.

everyone designs every day and everyone has even the defined individual abilities of designers to a certain extent.[13] This shows that the separation of individual knowledge, abilities, and tasks of disciplines does not correspond to reality. Researchers have already argued that because problems around us are becoming increasingly complex, design may even have to be "'undisciplined' in its nature" so that the abilities and tasks of several disciplines can be combined to solve specific problems.[14]

Collaboration works best when each person in a group can contribute their best abilities. This is based not only on the discipline the person belongs to but, more important, on the other people involved. Each person has several abilities and tasks they master differently depending on their background. Depending on which and how many people work together, each person's best abilities in comparison with the others change. For this reason, more people should be able to collaborate regardless of discipline. They need the ability to identify and understand relevant problems and solution approaches in different areas to create relevant solution concepts collaboratively. We show how the effect method makes that possible.

Identifying Instead of Defining Problems and Solutions

Regarding the definition above, several researchers asked: "Who determines the 'courses of action' and whose 'preferred situations' are we to design?"[15] The allegedly specific problems designers address individually are called "design problems." Researchers define them as "wicked," not clearly definable, and ill-structured; the designer must first deconstruct them to tame them.[16] With individual knowledge, abilities, and creativity, designers are expected to create unilateral solutions for multilateral problems. However, all problems can be described as wicked or tame, with wickedness being the norm to begin with.[17] Regarding the specific design problems, it can also be argued that the market offers "new solutions for old problems" and the "invention of problems for new solutions"; thus, design must analyze and define problems more clearly to improve quality of life.[18]

If problems and solutions are considered in a system rather than independently, defining simple problems and solutions is challenging. Conditions in a system change permanently, and not all interrelations can be considered. We need prior knowledge to define problems and solutions, and it is difficult to justify this decision regarding its relevance compared with other problems and solutions. Furthermore, we deal with the problems and solutions in detail only after we have defined them. If we research defined interrelations between subjects (terms considered as single entities) and systems (terms considered as multipart entities) with the effect method, we acquire knowledge, understand relevant problems

14 Craig Bremner and Paul Rodgers, "Design without Discipline," *Design Issues* 29, no. 3 (Summer 2013): 4–13, https://doi.org/10.1162/DESI_a_00217.

15 D. J. Huppatz, "Revisiting Herbert Simon's 'Science of Design,'" *Design Issues* 31, no. 2 (Spring 2015): 29–40, https://doi.org/10.1162/DESI_a_00320.

16 Chanpory Rith and Hugh Dubberly, "Why Horst W. J. Rittel Matters," *Design Issues* 23, no. 1 (Winter 2007): 72–91, https://doi.org/10.1162/desi.2007.23.1.72; Chun-Heng Ho, "Some Phenomena of Problem Decomposition Strategy for Design Thinking: Differences between Novices and Experts," *Design Studies* 22, no. 1 (2001): 27–45, https://doi.org/10.1016/S0142-694X(99)00030-7.

17 Robert Farrell and Cliff Hooker, "Design, Science and Wicked Problems," *Design Studies* 34, no. 6 (2013): 681–705, https://doi.org/10.1016/j.destud.2013.05.001; Richard Coyne, "Wicked Problems Revisited," *Design Studies* 26, no. 1 (2005): 5–17, https://doi.org/10.1016/j.destud.2004.06.005.

18 Wolfgang Jonas, "Design as Problem-Solving? Or: Here Is the Solution—What Was the Problem?," *Design Studies* 14, no. 2 (1993): 157–70, https://doi.org/10.1016/0142-694X(93)80045-E.

19 Chia-Chen Lu, "The Relationship between Student Design Cognition Types and Creative Design Outcomes," *Design Studies* 36 (January 2015): 59–76, https://doi.org/10.1016/j.destud.2014.08.002.

20 J. Poon and M. L. Maher, "Co-Evolution and Emergence in Design," *Artificial Intelligence in Engineering* 11, no. 3 (1997): 319–27, https://doi.org/10.1016/S0954-1810(96)00047-7.

21 Nigel Cross, "The Coming of Post-Industrial Design," *Design Studies* 2, no. 1 (1981): 3–7, https://doi.org/10.1016/0142-694X(81)90023-5; Leon Cruickshank, "The Innovation Dimension: Designing in a Broader Context," *Design Issues* 26, no. 2 (Spring 2010): 17–26, https://doi.org/10.1162/DESI_a_00002.

22 Charles L. Owen, "Context for Creativity," *Design Studies* 13, no. 3 (1992): 216–28, https://doi.org/10.1016/0142-694X(92)90200-T; Richard Coyne, "Creativity as Commonplace," *Design Studies* 18, no. 2 (1997): 135–41, https://doi.org/10.1016/S0142-694X(97)85456-7.

and solution approaches, and can justifiably identify them. The interrelations are defined by effects to be prevented (problem) or achieved (solution).

Based on the defined subject of interest, the system we want the subject to be put in relation to, and the effect between them, we can specify the system (who is most affected or can affect the most) and the time (when are they most affected or can affect the most) alternately with research questions. Thus, we can effectively identify when and which parts of the system are most negatively affected (problem) and can most positively affect this problem (solution approach). Thanks to the knowledge acquired and our individual knowledge, best abilities, and creativity, we can collaborate with experts and people in different areas and creatively develop which parts could make the positive effect work best (solution concept).

Creativity through Collaboration Instead of Individuality

The individual creativity of designers is often the foundation for research and methods, which should then influence many other disciplines. As Chia-Chen Lu suggests, "solution-driven design can considerably predict creativity."[19] Furthermore, co-evolution as "the designerly way to interpret & re-interpret problems" is becoming increasingly important for other disciplines.[20] However, the individual creativity of designers will become less important in the future as collaboration increases in importance, and design as a discipline can only be one part of the innovation process.[21]

It can be argued that "creative thinking is not confined to the few" and that creativity can even be seen as commonplace.[22] A collaborative understanding of knowledge and creativity builds on collaboration, combination, and creation. More knowledge does not limit creativity. Free individual creativity with little knowledge creates more problems than it solves, and more knowledge and creative people enhance creativity and relevant solutions. As Bo T. Christensen and Linden J. Ball indicate, there is a "direct route from knowledge diversity through analogical reasoning to novel idea production."[23]

Furthermore, users of designs already make "important contributions to designs."[24] If more people are empowered to understand and identify problems and solution approaches with knowledge in different areas, they can be part of the creative development of solution concepts.

Collaborative Instead of Individual Problem-Solving

Designers must acquire knowledge from several areas in the design-centered understanding of problem-solving.[25] However, solving problems needs not only the knowledge but also the abilities and creativity of several people. A collaborative understanding of

23 Bo T. Christensen and Linden J. Ball, "Creative Analogy Use in a Heterogeneous Design Team: The Pervasive Role of Background Domain Knowledge," *Design Studies* 46 (2016): 38–58, https://doi.org/10.1016/j.destud.2016.07.004.

24 Cindy Kohtala, Sampsa Hyysalo, and Jack Whalen, "A Taxonomy of Users' Active Design Engagement in the 21st Century," *Design Studies* 67 (2020): 27–54, https://doi.org/10.1016/j.destud.2019.11.008.

25 Luz María Jiménez Narváez, "Design's Own Knowledge," *Design Issues* 16, no. 1 (Winter 2000): 36–51, https://doi.org/10.1162/074793600300159583.

problem-solving combines the individual knowledge, best abilities, and creativity of each person into a collaborative process. How can a person identify problems if they have limited knowledge about the area they are looking at? The big challenge so far has been to enable people to acquire knowledge from areas that are foreign to them, understand and identify problems simultaneously, and be able to justify the relevance of these problems. We show how the effect method makes this possible and enables people to identify relevant solution approaches to get creative and develop solution concepts collaboratively.

Objectively Justifying Instead of Subjectively Assessing Relevance

Can designers address relevant problems at all? Ann Thorpe states, "designers are trained to respond to clients and consumers, and to add value to businesses. Governments develop policies that position design as a tool of economic growth."[26] Furthermore, through individual points of view, designers "may unwittingly stage differences that reinforce power differentials or exclusions for those marginalized, invisible, or oppressed."[27]

The relevance of those design problems and problems with design is not weighted. The individual designers, like every other person, feel their highest level of compassion for themselves, then for people close to them, people they know, people they do not know, and finally, for people they do not know exist at all. People connect through feelings, which are most easily transmitted in direct actual exchange. We feel this bilaterally perceived exchange between close people and us distinctly, but the multilateral system behind it only very vaguely.

According to Victor Margolin and Sylvia Margolin, "the market does not, and probably cannot, take care of all social needs," as some people are not consumers according to the market sense, such as socioeconomically disadvantaged people.[28] Angharad Thomas adds that those in extreme poverty "do not constitute a market for designed or designer goods."[29] As Guy Julier and Lucy Kimbell put it, "neoliberalism requires inequalities and [...] social design's institutional location limits its capacity to address them."[30]

We want to solve these problems of individual design-centered problem-solving through collaborative effect-centered problem-solving. Contrasting the subjective assessment of relevance with an objective model is crucial, with which it is easy to identify and justify relevant problems in different areas. The effect method makes this possible because the research questions identify the parts of the system that are most negatively affected by a subject. It is certainly an ethically debatable valuation, but it is systematically logical and correct. If one does not support the most affected parts of a system, it becomes unbalanced and collapses. The most

26 Ann Thorpe, "Design's Role in Sustainable Consumption," *Design Issues* 26, no. 2 (Spring 2010): 3–16, https://doi.org/10.1162/DESI_a_00001.

27 Sarah Fox, Catherine Lim, Tad Hirsch, and Daniela K. Rosner, "Accounting for Design Activism: On the Positionality and Politics of Designerly Intervention," *Design Issues* 36, no. 1 (Winter 2020): 5–18, https://doi.org/10.1162/desi_a_00571.

28 Victor Margolin and Sylvia Margolin, "A 'Social Model' of Design: Issues of Practice and Research," *Design Issues* 18, no. 4 (Autumn 2002): 24–30, https://doi.org/10.1162/074793602320827406.

29 Angharad Thomas, "Design, Poverty, and Sustainable Development," *Design Issues* 22, no. 4 (Autumn 2006): 54–65, https://doi.org/10.1162/desi.2006.22.4.54.

30 Guy Julier and Lucy Kimbell, "Keeping the System Going: Social Design and the Reproduction of Inequalities in Neoliberal Times," *Design Issues* 35, no. 4 (Autumn 2019): 12–22, https://doi.org/10.1162/desi_a_00560.

affected people are precisely the ones who need the most substantial support. As a result, more and more people are better off, and inequality decreases.

Next, we compare the two centralities based on problem identification, solution approach identification, and the development of the solution concept.

Problem Definition (Design-Centered)

How do designers define problems? Regarding the "problem as design goal," Steve Harfield states that it "is created by the imposition on to the 'problem as given' of a range of designer preferences, expectations and prejudices which not only define the 'actual' problem but, at the same time, establish the means and requirements for its acceptable solution."[31] Ann Heylighen and Andy Dong indicate, "the presence or absence of the designer's own values during the process of gaining empathy will determine trade-offs and therefore the social impact of the design."[32]

Furthermore, when defining problems, it is uncertain whether the problems perceived by the people involved are the reason for their unwanted condition or whether the condition needs to change. The possibility of sharing knowledge to convince people of the identified problems to solve needs to be addressed. It is easier and therefore more profitable to make people happy in the short term with something they do not need than to identify their real problems, explain them to them, and sustainably solve them.

Problem Identification (Effect-Centered)

According to a study by Corinne Kruger and Nigel Cross: "Designers using a solution driven strategy tended to have lower overall solution quality scores but higher creativity scores. Designers using a problem driven design strategy tended to produce the best results in terms of the balance of both overall solution quality and creativity."[33] If we research defined interrelations between subjects and systems, we acquire knowledge to understand problems and can justifiably identify them simultaneously. The interrelations are defined by effects to be prevented. Based on the subject, system, and effect, we can specify the time (when) and the system (who) alternately. Thus, we can effectively identify which parts of the system are most negatively affected. To understandably show how the effect method can be used to identify relevant problems and solution approaches in very complex areas—without losing details, we choose the subject of cancer and the system of humanity. In this interrelation, we want to prevent the life-threatening effect of cancer on humanity.

To identify the problem, we research the following questions:

1. When does the subject have the chosen effect on the system?

31 Steve Harfield, "On Design 'Problematization': Theorising Differences in Designed Outcomes," *Design Studies* 28, no. 2 (2007): 159–73, https://doi.org/10.1016/j.destud.2006.11.005.

32 Ann Heylighen and Andy Dong, "To Empathise or Not to Empathise?: Empathy and Its Limits in Design," *Design Studies* 65 (November 2019): 107–24.

33 Corinne Kruger and Nigel Cross, "Solution Driven versus Problem Driven Design: Strategies and Outcomes," *Design Studies* 27 (September 2006): 527–48, https://doi.org/10.1016/j.destud.2006.01.001.

Cancer has a life-threatening effect on humanity when it metastasizes.

2. Which group is most affected by this condition?
   People with breast cancer are most affected by metastasis.
3. When is this group most affected by this condition?
   People with breast cancer are most affected by metastasis when the breast cancer has already metastasized at initial diagnosis (de novo metastatic breast cancer).
4. Which parts of this group are most affected by this situation?
   Middle-aged women are most affected by de novo metastatic breast cancer.
5. When are these parts most affected by this situation?
   Middle-aged women are most affected by de novo metastatic breast cancer when they have a low socioeconomic status.

Instead of defining a problem, we researched the defined interrelation between cancer and humanity and identified a problem (the moment at which the parts are most affected) whose relevance we can justify. In addition, we have acquired knowledge that enables us to continue the process and collaborate.

Solution Approach Definition (Design-Centered)

With what knowledge do designers become creative? Bruce Hanington says that "it is not necessary for designers to become scientists, but they ignore the tenets of good science at their peril."[34] Without further knowledge acquisition, the initial definition of the problem is usually followed directly by the creative generation of ideas, in which designers use their individual creativity to develop novel approaches. These can be quickly tested and evaluated using simple prototypes. Research should be done beyond checking the novelty of the solution approaches and the possible willingness of people to buy. The fact that the respective designers need to gain the necessary expertise for the subject, as their training is often concentrated on reaching people's desires, is readily omitted. This underscores the low relevance of many projects because knowledge acquisition is not considered important enough to be a part of defining solution approaches.

On the other hand, the training to create desire is put to perfect methodological use, as they can shape the solution approach more and more appropriately in direct exchange with the people involved. If the goal is that the people desire what is designed, it can be initially unconsciously irrelevant to both parties whether the solution approach solves the defined problem.

34 Bruce Hanington, "Relevant and Rigorous: Human-Centered Research and Design Education," *Design Issues* 26 (Summer 2010): 18–26, https://doi.org/10.1162/DESI_a_00026.

Solution Approach Identification (Effect-Centered)

We do not risk developing irrelevant solutions by not getting creative directly. Therefore, we research the parts of the system of humanity we have defined that can most positively affect the identified problem. For this, we define the life-enabling effect, as we want to achieve this in the interrelation of the system and problem.

To identify the solution approach, we research the following questions:

1. How can the system have the chosen effect on the problem?
   Humanity can have a life-enabling effect on middle-aged women with low socioeconomic status and de novo metastatic breast cancer with novel screening modalities suited for biologically aggressive breast tumors.
2. Which group can most affect this condition?
   Researchers can most affect novel screening modalities suited for biologically aggressive breast tumors.
3. How can this group most affect this condition?
   Researchers can most affect novel screening modalities suited for biologically aggressive breast tumors by focusing on identifying biomarkers for early detection.
4. Which parts of this group can most affect this situation?
   Their ability to evaluate biomarkers using appropriate metrics can deliver the greatest effect focusing on identifying biomarkers for early detection.
5. How can these parts most affect this situation?
   By using metrics, researchers can assess the performance of potential biomarkers in distinguishing between different types of breast cancer and their aggressiveness.

We specified our system into a group and parts and the wanted condition into a situation and a moment. However, we want to find a solution approach that addresses the identified problem more specifically. We define "biomarkers" as a system to identify the specific biomarkers whose diagnosis can most positively affect middle-aged women with low socioeconomic status and de novo metastatic breast cancer. Biomarkers can have a life-enabling effect by aiding in cancer prognosis (condition). Blood, nipple aspirate fluid, sweat, urine, tears, or breath (group) can most affect this condition by holding keys for early detection of breast cancer (situation). Nipple aspirate fluid (parts) can most affect this situation by displaying the presence of specific biomarkers (moment).

To find out which type of diagnosis of nipple aspirate fluid is best, we define it again as a system and repeat the questions. Nipple aspirate fluid can be collected through nipple aspiration (condition). A diagnostic kit (group) can most affect this condition by empowering women to express samples at home monthly

or quarterly (situation). A triage test (parts) can most affect this situation by providing advantages such as simplicity and low costs (moment).

In several iterations of specification, starting from the system, the identified problem, and the effect we want to achieve, we found a justifiable, relevant solution approach. We learned a great deal about the interrelation of the subject, problem, and systems—the knowledge that we now need to be creative and collaborate with other disciplines. Studies confirm that a focused search in an unusual area for the problem solver facilitates novel concepts, and inspiration in this area supports the quality of ideas.[35]

Solution Concept Development (Design-Centered)

How far do designers develop solution concepts? Developing the solution concepts focuses on further adapting to the people's wishes until they are satisfied. This is often measured by whether they would buy the presented concept. If the people involved want the solution concept, the project is complete, and the people and designers are happy. The lack of collaborative consideration of the problem-solving process and the lack of systematic consideration of the actions and the new creations by the designers lead to solutions that tend to create more problems than they solve. The people involved usually notice this late and are dissatisfied with the solution. However, the designers are already in the next creative generation of ideas to create negatively relevant solutions for irrelevant problems.

Solution Concept Development (Effect-Centered)

Even though we are not physicians, we can now begin working on our first creative thoughts about a solution concept. After preliminary work of identifying a relevant problem and solution approach, we can consider which part of a low-cost triage test could make the effect work. The resulting creative generation of ideas is made possible by knowledge acquisition and the structure of the questions.

To develop the solution concept, we research the following questions:

1. How could the system have the chosen effect on the problem? A simple and low-cost triage test could have a life-enabling effect on middle-aged women with low socioeconomic status and de novo metastatic breast cancer if used before the existing imaging methods.
2. Which group could most affect this condition? The Guthrie card collecting method could most affect the usage before the existing imaging methods.
3. How could this group most affect this condition? The Guthrie card collecting method could most affect the usage before the existing imaging methods by being

35 Ut Na Sio, Kenneth Kotovsky, and Jonathan Cagan, "Fixation or Inspiration? A Meta-Analytic Review of the Role of Examples on Design Processes," *Design Studies* 39 (July 2015), https://doi.org/10.1016/j.destud.2015.04.004; Joel Chan, Steven Dow, and Christian Schunn, "Do the Best Design Ideas (Really) Come from Conceptually Distant Sources of Inspiration?," *Design Studies* 36 (January 2014), https://doi.org/10.1016/j.destud.2014.08.001.

inexpensive, noninvasive, reliable, and painless. Guthrie cards can be stored at room temperature and are suitable for mass spectrometry analysis.

We can now creatively develop the specific parts of the triage test system and the specific moment when the parts might best make the desired effect work. Building on the consideration of a way for the women to obtain nipple fluid independently, efficiently, and as sterile as possible and place it on the cards, we are developing a solution concept.

4. Which parts of this group could most affect this situation?
   The part at the front of conventional plastic syringes could be removed, and the inner part fitted with a spring. This would possibly allow women to obtain nipple fluid with one hand and constant pressure, reducing the risk of injury, and use the other hand, which would remain sterile, to dab the fluid with a Guthrie card. The kit could then be returned, and the samples analyzed using mass spectrometry.
5. How could these parts most affect this situation?
   This concept could provide an inexpensive and easy-to-execute way to rapidly test large numbers of women for the biomarkers that indicate a high likelihood of breast cancer. Ultimately, breast cancer might be detected and prevented before it spreads to other places in the body.

To discuss and further develop our solution concept with the help of experts and other people in a sustainable and system-compatible way, we can check the effects of our solution concept on other parts, groups, and systems. Thus, identifying the solution concept brings us back to the beginning of the process, where we can, for example, research when the solution concept would negatively affect the environment. As Stuart Walker said, we need to "develop ways forward that are considerate of the effects our various endeavours have on natural places and systems."[36]

Outlook

Regarding the future, several researchers attribute increasing importance to this collaborative problem-solving process. According to Nigel Cross:

> It is possible that another, third version of design thinking as a way of acting within complex, problematic issues may be emerging. This new version could extend design thinking out of the making paradigm of professional design practice, towards a competency, a way of thinking and working that embodies a broader form of strategic, adaptive, co-operative intelligence for engaging with wicked problems.[37]

36 Stuart Walker, *Design for Life: Creating Meaning in a Distracted World* (London: Routledge, 2017).

37 Nigel Cross, "Design Thinking: What Just Happened?," *Design Studies* 86 (May 2023): 101187, https://doi.org/10.1016/j.destud.2023.101187.

We argue that the effect method goes beyond the previous problem-solving methodology, as it enables people, regardless of disciplines and prior knowledge, to identify relevant problems and solution approaches and empowers them to contribute their knowledge, best abilities, and creativity to the collaborative development of creative solution concepts.

Conclusion

At the beginning of the article, we pointed out the attempts in design studies to achieve the individuality of design by separating it from other disciplines. We explained how this leads to a design-centered understanding and execution of problem-solving, where designers are expected to use their individual knowledge, ability, and creativity to develop solutions to specific problems. We argued that creativity is found through collaboration between people and that each person has knowledge, abilities, and tasks that can be attributed to several disciplines. With an example, we demonstrated the disadvantages of a design-centered understanding and execution of problem-solving as well as the advantages of a collaborative effect-centered understanding and execution with the effect method. We argued that collaboration and knowledge sharing between people fosters creativity and improves the quality of solutions. However, people need the ability to identify and understand relevant problems and solution approaches to develop concepts creatively and collaboratively. We illustrated how the effect method can be used to acquire knowledge to identify and simultaneously understand relevant problems and solution approaches to enable the creative and collaborative development of solution concepts.

With the newly developed effect method, we propose a new collaborative understanding of the problem-solving process that can create social, environmental, and economic sustainability, counteracting many forms of inequality.

Let's affect the world together!