

Using Metaphorical Design to Reveal New Perspectives in Systems Design – Insights From a Participatory Design Workshop for Research Data Platforms

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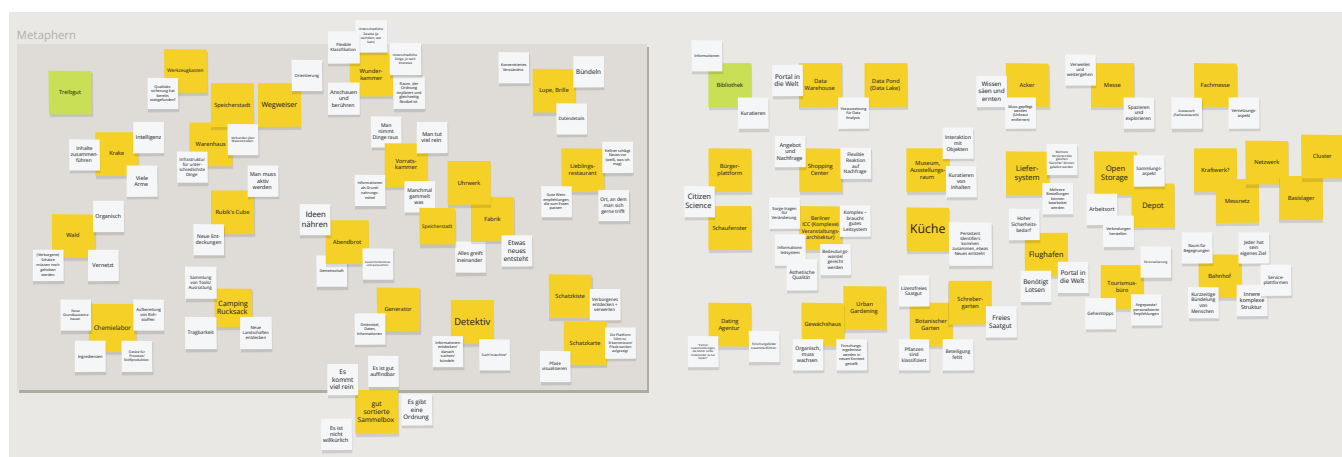


Figure 1: Metaphors collected during the second workshop session. Green post-its are metaphors introduced by facilitators. Yellow post-its are metaphors by participants, and white post-its contain additional information provided by the participants (used as bridging concepts).

ABSTRACT

Metaphorical design is a Participatory Design technique suitable for problem setting and concept development. The technique can be particularly constructive when designing (computer) systems in an already digitalized environment. In such contexts, designers might be tempted to draw on readily available technical solutions, thus hampering the discovery of new perspectives. Our use case is the development of a research data platform that aims to provide innovative functionality, especially for assessing and exploring digital resources. We developed a participatory workshop format adapting metaphorical design that first creates a shared understanding of the context and then guides participants to generate metaphors using

a projective technique. We show how we used these metaphors to understand the participants' model of the research data platform, to identify possible domains of activities, and to stimulate new viewpoints on the research data platform and its functionality. With this paper, we provide an application example of the adapted metaphorical design process, propose a metaphor evaluation matrix, and discuss the findings.

CCS CONCEPTS

- **Software and its engineering** → **Software design techniques**;
- **Human-centered computing** → *Participatory design*.

KEYWORDS

metaphorical design, innovation, problem-setting, systems design

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1 INTRODUCTION

When designing (computer) systems in an already digitalized environment, one is tempted to draw on readily available technical solutions. This can, for example, mean that the new system is designed using technology developed for other systems, or that existing, and similar, systems provide such a strong model that new approaches are disregarded. Although this resort to pre-existing solutions can lead to satisfactory results, it may prevent innovative design approaches and hamper the discovery of new perspectives and interpretation of systems. Our use case is the development of a research data platform for universities, aiming to provide innovative functionality especially for the assessment and exploration of digital resources (e.g. scientific data, publications, metadata). At this point of time in the project, many stakeholders had already contributed their expectations to the concept, and a first technical pilot had been developed. This pilot followed closely the design of existing research data platforms, for example, by providing interactive visualizations. In contrast, however, prospective users had not been involved so far, neither had a requirement analysis been conducted, nor had new approaches been considered. Thus, we decided to apply the metaphorical design technique [11], a Participatory Design (PD) technique suitable for the stage of problem setting and concept development. More specifically, Halskov Madsen [11, p.61] describes problem setting as follows: “The problem to be solved by computerization is not known beforehand, and its identification is taken as an explicit issue to be considered.” Thus, this technique allows user participation and opens the design space for new approaches. Adapting the metaphorical design process, we developed a participatory workshop format that first creates a common understanding of the context, and then guides participants to generate metaphors using a projective technique. In the following metaphor processing, the metaphors are examined to understand the model participants have of the research data platform, to identify possible domains of activities, and to stimulate novel perspectives on design. Along with the workshop setup, we introduce the metaphor evaluation matrix and present results of the metaphorical design process.

2 BACKGROUND

The research presented in this article is part of a project which aims to develop a research (data) platform for several collaborating universities. The goal is to provide a platform for researchers, which interlinks digital resources, for example, scientific publications and research data, that are available at the partner institutions. It is envisioned that the platform provides enhanced tools to search and explore, and also to analyse scientific data and information. The digitalisation and opening up of science, and, more precisely, research data infrastructures, is currently a heavily discussed topic. Prominent initiatives on a European level are the European Open Science Cloud (EOSC)¹ and on a national level the National Research Data Infrastructure Germany (NFDI)². Guiding principles to set up such

research data infrastructures are the FAIR data principles [22]. To enable powerful infrastructures and tools, semantic technologies and (research) knowledge graphs are on the rise. These enable the interlinking of digital artifacts. One prominent example that is built with these technologies is Wikidata³, which forms the technical foundation of Wikipedia.

2.1 Participatory Design

Through Participatory Design methods, researchers have strived to include workers in the design process during the introduction of computer systems. Those who would have to use the systems later on, should be heard and considered in their development. In “Design at work” [8], Greenbaum and Kyng [8, p.1-2] outline their ideals for a design process in cooperative or participatory design as follows: The aim should be full participation from the users during the design process. Computers should enhance workplace skills, they should be seen as tools and users need to have control over them. Computer systems should not only be considered to increase efficiency, but also to increase the quality of the results. Conflicts that may come up during the design process need to be confronted. Starting point for the design process has to be the use situation. Since then, participatory design has diversified into a broad range of techniques and approaches (for an overview see Halskov and Hansen [9]), including the metaphorical design technique (e.g. [10, 11, 15]).

2.2 Metaphor in HCI

In human computer interaction (HCI), the term *metaphor* is often connoted to the desktop metaphor, a user interface metaphor. The desktop metaphor “provide[s] the user[s] with a model of the system” [7, p.67], who assume that a file is actually moved when they drag it from one folder to another. The real world experience (moving something physically from one place to another) is matched in the digital reproduction – where, in fact, the only thing that changes is the pointer to the file (for this example see Erickson [7, p.66]). Furthermore, the virtual desktop features even more objects from the real world, such as data sheets, folders, and a dustbin. This similarity is assumed to provide users with an instantaneous understanding of the system’s functions and to increase learnability of new systems (compare e.g. Carroll [5, p.71]). For a general summary of the origin and history of the user interface metaphor see Blackwell [3]. Additionally, Hamilton [12] expands on metaphor theory and how metaphors in HCI can influence attitudes and beliefs.

Apart from interface design, metaphors can be applied to foster innovation in the process of systems design. Here, they can support designers in problem setting and in developing new viewpoints, thus promoting new ideas. Halskov Madsen [10] proposes to use metaphors consciously in systems design to identify domains of activity appropriate for computerization. This way, knowledge about the source domain (the metaphor) can become “a potential source of inspiration for designing new options” [10, p.II]. In metaphorical design, it is essential to “see one thing as another thing” [10, p.4], building on Lakoff and Johnson’s [18] observation that metaphors are omnipresent in human language. As an example, a metaphor could be used to see a person as an animal (e.g. a bear). In such a

¹For further information, please see www.eosc.eu.

²For further information, please see <https://www.nfdi.de/?lang=en>.

³For further information, please see www.wikidata.org.

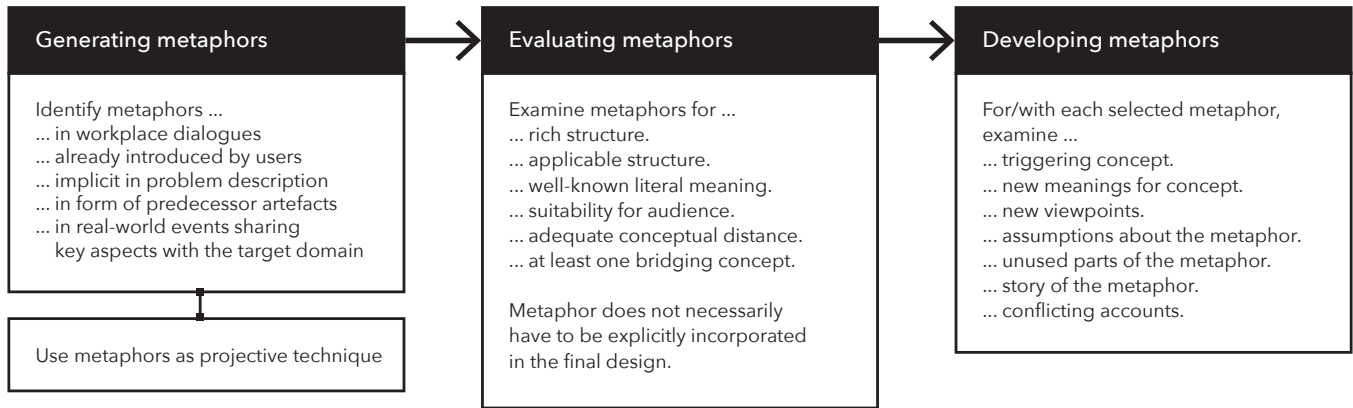


Figure 2: Guidelines for the metaphorical design process, as described by Halskov Madsen [11]. These encompass the main activities of metaphorical design, from the generation of suitable candidate metaphors, to their evaluation and development. Widening the first activity, the generation of metaphors, we propose to use metaphors as a projective technique. For our complete setup, see Figure 3.

way we would assign assumptions or knowledge about the animal (e.g. being fierce, being strong) to the description of the person (who we would assume to be as fierce and as strong as a bear). A similar procedure can be applied in systems design, transferring knowledge from metaphor to target domain. Kensing and Halskov Madsen [15] use metaphorical design connected to a future workshop to create visions for the introduction of computer systems together with participants, resulting in ideas like an electronic bulletin board. In a similar vein, Lockton et al. [19] employ metaphor cards for the juxtaposition of ideas and present a collection of new app concepts. Stubblefield [21] describes how the metaphor of a spelling-checker facilitated the design and development of a machinability advisor system, and fostered dialogue between stakeholders and team members. Using the metaphor cards by Lockton et al. [19], Alves-Oliveira et al. [1] employ metaphors to counter prevalent assumptions about robots, widening the perspectives in human-robot-interaction.

3 METAPHORICAL DESIGN

In [11], the guidelines for metaphorical design encompass three main activities, from the *generation of metaphors* through their *evaluation* to the *development of metaphors* (see Figure 2). In the first activity, metaphor generation, metaphors could be derived from workplace dialogues, from metaphors already in use in the workplace, from predecessor technologies, from problem characteristics, or from existing technical solutions or artifacts that share same key aspects [11, p.59]. In the second activity, the suitability of the candidate metaphors is evaluated. The metaphors should have a “rich structure”, i.e., should possess exploitable aspects, the metaphors should not be misleading and should be easily understood by the users. Their literal meaning and functioning needs to be known (as we are trying to understand a less familiar concept by drawing on a more familiar concept). For the same reason, the metaphors should not be too close to the target domain and should have at least one “bridging concept”, i.e., a common characteristic between the *target domain* and the *source domain* [11, p.59-60]. The new concept (in our case a research data platform) is in the target

domain and the metaphor is in the already familiar source domain. In the third activity, the development of metaphors, the metaphors are examined and refined. This includes the search for triggering concepts, ideas like “service” or “meeting” that connect both original concept and metaphor. In this stage, it is important to look for new meanings and to allow new viewpoints. This can be supported by examining relations between target and source domain and by “telling the metaphor’s story”. Aspects that the metaphor may hide or highlight, as well as unused aspects of the metaphor, should be pointed out, and different metaphors should be compared in their application to the target domain [11, p.60].

To include participants in the generation of metaphors, we propose to add “metaphors as a projective technique” (see Appendix A.1) as another option to the first activity. Putting this approach into practice, we ask participants to describe the intended system using a metaphor, and to explain their choice of metaphor. The technique draws on the same mechanism as metaphors, namely describing something unfamiliar (the intended research data platform) in terms of something already familiar (the metaphor). At the same time, a rich description of the participants’ model of the research data platform is created. In consequence, this approach necessitates a thorough introduction into the topic of research data platforms. Here, we looked at Kensing and Halskov Madsen’s [15] description of metaphorical design in the case of a library, within the setting of a *Future Workshop* (see Appendix A.2). A Future Workshop typically has three successive phases: the critique phase, the fantasy phase, and the implementation phase. In the library use-case, the metaphorical design process is mainly mapped to the first two stages: The critique phase was used to find metaphors in the expressions of the participants. The fantasy phase was used to derive new ideas from these metaphors (e.g. seeing the library as a meeting point lead to the idea of a electronic bulletin board) [15]. We took this setup as a basis and adapted it to our specific needs, creating a two-day participatory workshop, each day spanning a 2.5 hr session. The first session (based on the critique phase) was intended to enable participants to understand the context of research

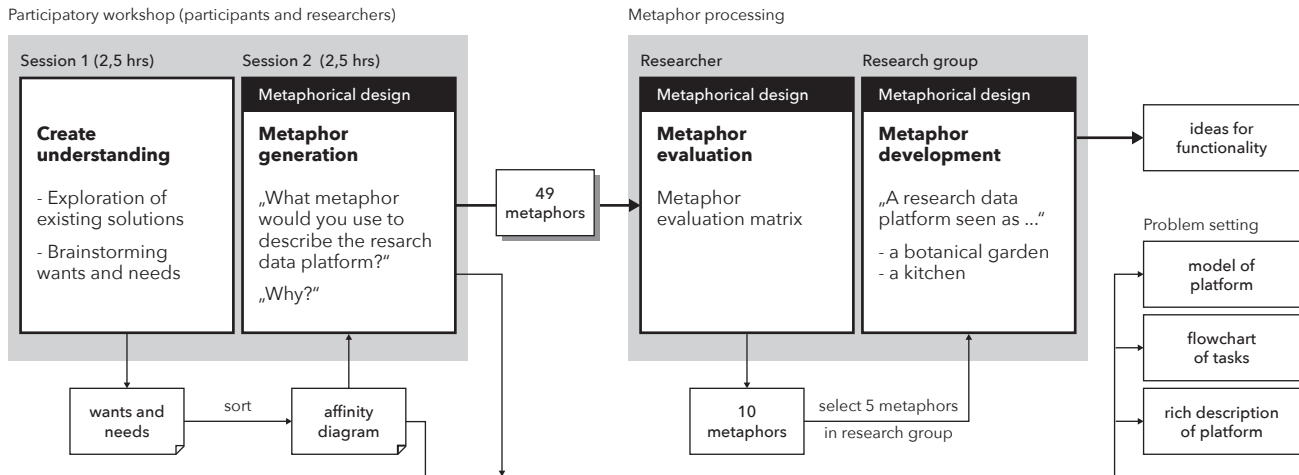


Figure 3: Structure of the adapted metaphorical design process based on [11]. The first part consists of a participatory workshop, spanning two sessions (to create an understanding and to generate metaphors). The resulting metaphors are passed on to the second part, where metaphors are further processed. This part is conducted in the research group and comprises *metaphor evaluation* and *metaphor development*, resulting in ideas for research data platform functionality. Additional results relevant for problem setting and concept development are derived from the affinity diagram, i.e. a model of the platform and a flowchart of tasks (see Figure 5). Finally, all workshop notes and metaphors contribute to a rich description of the research data platform, from the viewpoint of participants.

data platforms. The second session (based on the fantasy phase) was specified to collect metaphors from the participants, and to develop visions together with participants. Following these two workshop sessions, we carried out the remaining two activities of metaphorical design (evaluation and development) in the research group, summarized as “metaphor processing”. For an overview of the complete setup see Figure 3. Following, we describe both sessions of the participatory workshop in more detail and briefly outline the subsequent metaphor processing.

3.1 Participatory Workshop: Metaphor Generation

3.1.1 Session 1 - Create understanding and collect requirements. In the first session, we began by creating a common ground for understanding the concept of a research data platform, in general and specifically for the universities. We introduced the research project and the researchers. Next, we formed four teams, assigned each team one exemplary, already existing research data platform for exploration, and asked the teams to fill out a prepared form based on their insights. After this, the teams presented their results in plenary, thus sharing their knowledge. After a short break, we continued with a wants and needs analysis [2, p. 357], see also Appendix A.3. We asked participants to brainstorm:

- what *information* the research data platform should contain,
- which *tasks* they wanted to perform with it, and
- what *characteristics* the platform should have.

Following, we presented the results of the brainstorming in plenary and closed the session with a group discussion about the research data platform. In the days after the workshop, we prepared

the next session, sorted the brainstorming results in an affinity diagram (see Appendix A.4), assigning them categories.

3.1.2 Session 2 - Generate metaphors and create visions. We started the second session with a recollection of the first workshop. Next, we introduced the affinity diagram of the wants and needs analysis (see Figure 4), summarizing the requirements the participants had brainstormed for the research data platform. This way, we ensured that everybody was in the topic, and that three participants that had not taken part in the first session were aware of the findings. Then, we gave a brief introduction to metaphorical design and metaphors as projective technique (see Appendix A.1), and asked participants to describe the platform using a metaphor. We conducted two rounds, asking the participants first to describe the research data platform using any metaphor, and then, more specifically, to describe the research data platform by using an institution as a metaphor. That way, we intended to set a more specific focus, allowing a comparison between metaphors and triggering concepts. For results of the metaphor generation see Figure 1. Afterwards, we concluded by asking participants to formulate a vision of the research data platform and collected these visions on post-its.

3.2 Metaphor Processing: Metaphor Evaluation and Metaphor Development

After the two sessions of the participatory workshop, we continued the metaphorical design process. As illustrated in Figure 2, Halskov Madsen [11] names three main activities for this process: (1) generating metaphors, (2) evaluating metaphors and (3) developing metaphors. The first activity, the generation of metaphors, had just been conducted together with the participants in the second session of the workshop. The remaining two activities, metaphor



Figure 4: Affinity diagram summarizing the results of the wants and needs analysis. During the brainstorming, participants wrote down what *information* the research data platform should contain, what *tasks* they wanted to perform with it, and what *characteristics* the platform should have. After the workshop, results were grouped in categories by researchers.

evaluation and metaphor development, were then held in the research team (compare Figure 3). For evaluation, we introduced a metaphor evaluation matrix to identify candidate metaphors for further development. In the final activity, metaphor development, these selected metaphors were then used to examine the research data platform (target domain) in terms of the metaphors (source domains), namely by “*seeing* a research data platform *as*” one of the selected metaphors. Following, we present the results of our structured process.

4 RESULTS

We conducted the workshop in spring 2022 as an online workshop, due to the restrictions imposed by the COVID-19 pandemic. We recruited 23 participants from the university alliance, all working in projects within the same funding line, developing an integrated research environment for the participating universities. This way, we sought to ensure that all participants were prospective users, were already familiar with the specificities of the universities themselves, and had a certain level of knowledge about research data platforms. The first session had 19 participants, the second session 20 participants. In total, 16 people participated in both sessions. In an evaluation after the workshop, 17 participants provided personal details. Of these, one person was between 20 - 29 years, ten were between 30 - 39 years and six were between 40 - 49 years. Four participants identified as female, eleven as male, and two as non-binary. Following, we describe the collected data and activities of metaphorical design.

4.1 Model of Platform and Tasks

In the brainstorming of the first session, we collected wants and needs of the participants, regarding the research data platform. These results may have been influenced by the preceding task, i.e., the exploration of existing research data platforms. The findings turned out to be a comprehensive description of the platform itself, and of tasks to be performed with it. After the conclusion of the workshop, we analyzed the affinity diagram (see Figure 4) and our notes, and created a visual representation of the platform (see Figure 5). This illustration summarizes the main characteristics of the research data platform as indicated by the participants. Furthermore, we created a flowchart of tasks (see also Figure 5), connecting all tasks participants indicated they wanted to perform with the platform, and showing interdependencies and relations between the tasks. We discussed the findings in the research team and with stakeholders, where the visualization helped to expand on the intended unique features of the research data platform. Both visualizations serve as a common reference for all persons involved in the next steps of the design process, and as a means of communication. At the beginning of the second session, the visualization was also presented to the participants.

4.2 Metaphor Generation

In the second session, we collected metaphors and visions of the participants, regarding the research data platform (for resulting metaphors see Figure 1). The metaphors named by participants ranged from animals (octopus) over objects (tool box), events (dinner) and services (dating agency) to, as intended, institutions (museum, station, shopping center). In total, we collected 49 metaphors.

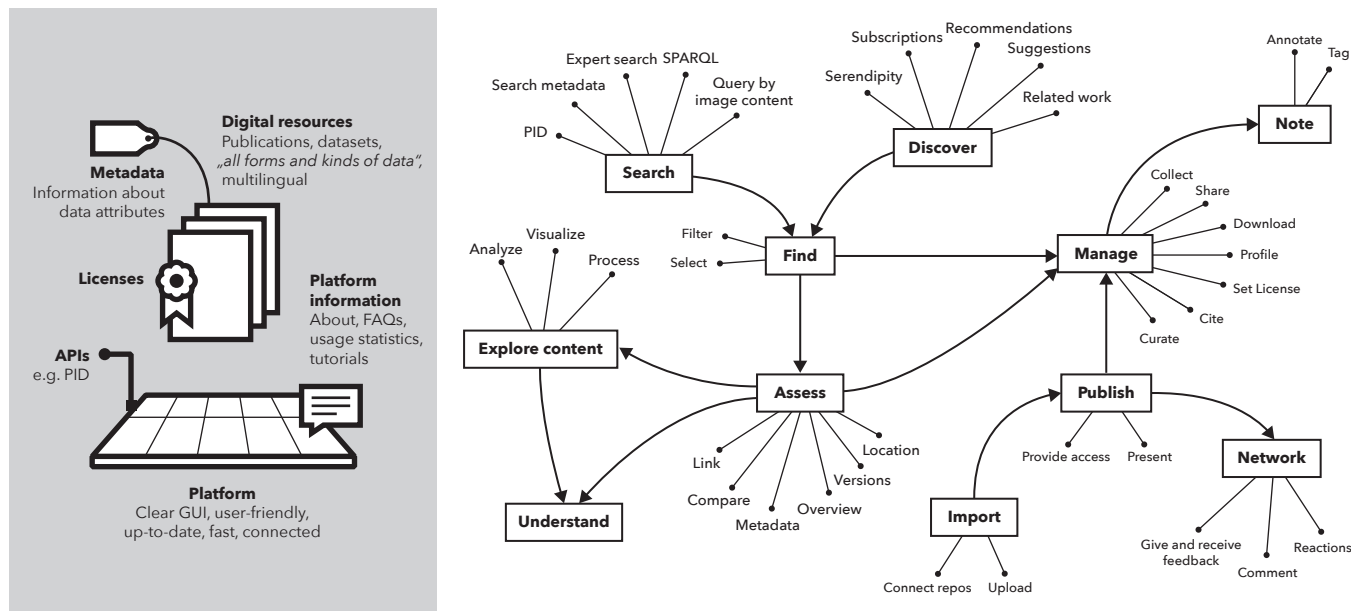


Figure 5: As a result of the first workshop session, we created an illustration of the research data platform, including characteristics and information (left). Furthermore, we created a flowchart of the tasks participants indicated they wanted to perform with the platform (right).

Furthermore, we analyzed the visions for additional findings. However, the visions were rather descriptive characteristics of the platform, for example, “innovative access”, “not yet another platform”, “open source”, “providing joy of exploration” and “dream: command line interface”, and provided no additional metaphors. All 49 metaphors were then passed onto the next step, the evaluation of metaphors.

4.3 Metaphor Evaluation

Halskov Madsen [11] names five criteria that metaphors should fulfil, namely suitability to audience, rich structure, adequate conceptual distance, applicable structure, and well-understood literal meaning (compare also Figure 2). Additionally, he states that metaphors should have at least one bridging concept, and that they do not need to be “explicitly incorporate[d] [...] in the final design” [11, p.60]. As we had a high number of 49 metaphors, we developed a *metaphor evaluation matrix* for a structured comparison. To identify bridging concepts, we drew on the connections participants had made during metaphor generation, when describing the platform (white post-its in Figure 1). We arranged the five criteria into an organized order, each criterion building on the preceding criteria (see Figure 6). One researcher thoroughly analyzed the first four criteria, narrowing the selection down from 49 to ten candidate metaphors. The last criterion (well-understood literal meaning) was then discussed in the research group, as well as the overall results, and five metaphors were selected for further development. Besides that, all metaphors were kept for further analysis, and to retain the rich description of the research data base.

4.4 Metaphor Development

For this article, we demonstrate the metaphor development of two of the five selected metaphors, namely *botanical garden* and *kitchen*. These metaphors had, for us, a well-known literal meaning, a rich and applicable structure, an adequate conceptual distance, and seemed suitable for users and stakeholders. We developed both metaphors following the guidelines by Halskov Madsen [11, p.60]. For a short summary of the method, please refer to section 3, specifically to the description of the third activity of the metaphorical design process, and compare Figure 2.

4.4.1 Botanical garden metaphor. We began by expanding our knowledge of the source domain through text research and discussed the metaphor in group. Following, we summarized our findings in bullet points describing a botanical garden:

- exhaustive annex of gardens,
- plants are grouped and displayed according to a systematic order,
- habitats are grouped and considered in the design of the garden,
- seed exchange with other botanical gardens is used to ensure complete collections, and
- the annex is open to the public and can be used for leisure.

We also considered additional notes taken during the workshop, regarding the metaphor *botanical garden* (white post-its in Figure 1): “licence free seeds”, “plants are classified” and “missing participation”. Then, we transferred the findings to the concept of the research data platform, by *seeing the research data platform as a botanical garden*. Seen as a botanical garden, the research data platform could be:

Metaphor	Bridging concept(s) by participants	Suitable to audience	Rich structure	Adequate conceptual distance	Applicable structure	Well-understood literal meaning
Airport	High security requirements, portal to the world, requires pilots	x	x	x	x	x
Botanical garden	Royalty-free seeds, free seeds, plants are classified, participation is missing	x	x	x	x	x
Kitchen	Persistent identifiers come together, something new is created	x	x	x	x	x
Dating agency	Bringing partners together who previously had nothing to do with each other, bringing research fields together	x	x	x	x	-
Delivery Service	Multiple versions of the same "dish" can be delivered, multiple orders can be processed	x	x	x	-	
Favourite restaurant	Place where people like to meet, waiter suggests new things (knows what I like), wine recommendations to go with the food	x	x	x	-	
Pantry	Take things out, put a lot in, information as a staple food, sometimes things rot	x	x	x	-	
Farmland	Sowing and reaping knowledge, must be cultivated/weeded	x	-			
Treasure map	Visualize paths, platform leads to insights, paths are shown	x	-			
Data lake/pond	Portal to the world, prerequisite for data analysis	-				

Figure 6: Excerpt of the metaphor evaluation matrix, based on the guidelines for metaphorical design by Halskov Madsen [11]. The first column shows ten (out of 49) metaphors, generated by participants in the second workshop session. The second column shows additional information and descriptions given by participants, that function as bridging concepts connecting source and target domain (extracted from white post-its, compare Figure 1). The following five columns show the remaining criteria metaphors have to meet. We suggest this order as it proceeds from more general to specific aspects. Metaphors that did not fulfil one criterion (cell with minus), were not considered in the following column (empty cell).

- exhaustive data platform, bringing together data from all members of the alliance,
- data/resources are grouped and displayed according to a systematic order,
- disciplines may be grouped,
- data “seeds” (e.g. as ORCIDs) may be exchanged with all members of the university alliance, or may be received from them, meaning the data is stored at one alliance member and accessible at the other, and
- the platform is open to the public who may use the data in other ways as research.

Summarizing our notes, we identified the following worthwhile triggering concepts between source and target domain:

- systematic order,
- conserve and display, and
- share.

These triggering concepts (or key concepts) may contribute to the general concept of the research data platform. Furthermore, it will be interesting to look for new features inspired by metaphors. Based on the botanical garden metaphor, we considered “digital resources” as plants in different stages, for example, seeds, saplings, full grown plants, flowers, but also as an object of study. The botanical garden metaphor raised the image of communal gardens, where

exchange was desired. In the research group, we found that the metaphors fostered dialogue and opened new viewpoints. We found new ways to talk about data and digital resources.

The following questions arose unordered, building on preceding ideas as inspiration: What if we want data to grow? How can we kindle it? What does it need to be nurtured? How could users interact with the data and with each other? One thing connected to botanical gardens is diligence and patience. Plants need time to grow (and can not be hastened) and they need nutrition. What is the plant in our context? The user or the data? Is the user a gardener? How do other people come into play? Can they add to growth? Can we provide “fertilizer” that pushes other users? Can we help them “weed” their data by checking for mistakes? Can we introduce a family of gardeners, working on the data together? Can we learn anything from botanical gardens when it comes to assessing data? Can we provide a visual overview? So far, there are already many computerized instances for searching, assessing, downloading, uploading etc. How can we identify new areas or domains of activity that could be introduced? Could we introduce a “growth phase”, a deceleration of the process? A slow analysis by technological means, showing the growth of the product? Could feedback be given of what has to be improved, what’s missing? In this fashion, we explored the metaphor and went through the process of seeing the research data platform as something else.

4.4.2 Kitchen metaphor. For the next metaphor, *kitchen*, we started by discussing our understanding of a kitchen. Were we talking about an industrial kitchen, a private kitchen or a family kitchen? What properties did these different kitchens exhibit, and what discoveries would these allow as a metaphor for a research data platform? Were we talking about single users (cooks), cooking alone, for their own consumption? Or about one person cooking for a group of people? Or about a group of people cooking for a group of people? We noted the following characteristics of a kitchen:

- room used to prepare (and sometimes also consume) food,
- ideally equipped with all appliances and tools needed to prepare a variety of dishes,
- provisions are necessary for cooking, they may be stored in the kitchen or in a separate room,
- recipes may be used to pass on knowledge about the preparation of dishes, and
- cooks work in a kitchen and specialize in preparing food.

We also considered further notes taken during the workshop, regarding the metaphor *kitchen* (white post-its in Figure 1): “persistent identifiers come together”, and “something new is created”. Then, we transferred the findings to the concept of the research data platform, by *seeing the research data platform as a kitchen*. Seen as a kitchen, the research data platform could provide:

- platform to search for and use data,
- variety of tools necessary to analyse data,
- additional information needed to work with data (e.g. licenses and meta data),
- directions to prepare the data for conversation (quality assurance) or to work with data, and
- place for teamwork and community.

Summarizing our notes, we identified the following worthwhile triggering concepts between source and target domain:

- specific and handy tools,
- preparation and consumption, and
- teamwork.

Based on the kitchen metaphor, we considered “digital resources” as staple food, provisions, condiments or dishes, but also as nourishment, flavour, and as different tastes and cuisines. The kitchen metaphor raised the image of vast or small, little or well equipped kitchens. We discussed that cooked food needs to be consumed, else it will be wasted, that sometimes staples rot in storage, and that well prepared conserves can be used well after their date of manufacture. We observed that, even when using the same recipe, a dish may taste different, depending on the cook, and that sometimes dishes were “personalized” to accommodate a variety of preferences. We explored that kitchens often seem inviting, and one saying goes that during a party, everyone will end up in the kitchen. How could we create the research data platform equally inviting, for users of all levels of competence? Was it possible to digitally recreate and transfer the experience of cooking and eating together, of nourishment and enjoyment? Could we introduce “cooks” (data stewards) that prepare data for further consumption and suggest matching spices, and suitable recipes? What about digital “cooking competitions”, showing the contestants during their work with a specific data set? Could we introduce “data critics” comparable to food critics, and

rate the quality of a data set with “Michelin stars”? We wrote down our thoughts and discussed ideas in the research group.

4.5 Collection of Ideas for Functionality

Concluding our metaphor development, we created a collection of ideas for new functionality of the research data platform. We went through our notes, and marked ideas and concepts to be explored in the next stage of the project. During this process, we tried to develop the ideas further into the direction of the research data platform, and to derive ideas for (more) concrete functionality, without the need to explicitly install the metaphor into the new system.

Ideas derived from the *botanical garden* metaphor are:

- curated collections
- visual cues to describe “size”, “age” and “category” of data set, for example graphs looking similar to growth rings
- depiction of crowds, attracted by data sets
- data set contests (best growth, best flowers, ...)
- memberships (e.g. as friends of research data platform), members donating or spending time to optimize data sets
- mentorship for data sets

Ideas derived from the *kitchen* metaphor:

- different display modes, e.g. discovery mode or detail mode, similar to different kitchen layouts
- data critics (similar to food critics, Michelin stars)
- tools for analysis (e.g. scripts and code), similar to a drawer full of kitchen utensils
- “recipes” for data analysis (e.g. code snippets)
- “learning by doing” workshops or videos
- design as community space or feel good location
- casual layout (e.g. similar to a blog)

5 DISCUSSION

In this paper, we propose and demonstrate an adaptation of the metaphorical design process by Halskov Madsen [10, 11], consisting of a participatory workshop, followed by metaphor processing. We introduced two new elements to widen and facilitate the metaphorical design process with focus on problem setting and idea generation. (1) We propose to employ metaphors as a projective technique in the early stages of the project, and when new and innovative functionality is desired. This can help to generate an understanding of the users model of the intended platform. (2) We propose a metaphor evaluation matrix incorporating the guidelines for metaphorical design by Halskov-Madsen [11] to support a structured comparison of candidate metaphors. Following, we discuss our workshop aim, tools and results. Furthermore, we compare the method to existing research. We then reflect processes observed during our practice of metaphorical design, and consider limitations of our study.

5.1 Participatory Workshop and Metaphorical Design

The ongoing digitalization of private and work environments poses new questions for participatory design. In case new systems with an existing, dominant model are introduced in new workplaces (or, in our case, in a group of universities), it can be challenging

to remain open for innovative functionality, and to match the new system to the prospective users' model. In such a setting, the presented participatory workshop and subsequent evaluation can offer a productive approach that provides a rich description of the system from the perspective of users, while at the same time collecting metaphors for idea generation.

5.2 Metaphor Evaluation Matrix

To support metaphor evaluation, we introduced the metaphor evaluation matrix (see Figure 6). This matrix helps to compare the results of metaphor evaluation, and supports a meaningful selection of metaphors for further development. The order of the criteria is proposed according to our experience while filling out the matrix. We tried different sequences and found that following the proposed structure, (most) metaphors that did not fulfil one of the earlier criteria, would not fulfil the following criteria. Nevertheless we encourage researchers to consider other sequences, or, as a more time-consuming approach, to fill out all columns for each metaphor. Again, we urge designers not to discard the remaining metaphors, as they contribute to the rich description of the research data platform that participants provided and may be useful in later analysis. As Halskov Madsen [10, p.13] put it: "Don't empty the trash too soon!".

5.3 Relating Our Approach to Other Research on Metaphors and Metaphorical Design

In interface design, the overly literal application of metaphors, i.e. a design modeled closely after familiar objects, has drawn criticism. Instead, Khoury and Simoff [16] propose the concept of "elastic metaphors" to allow metaphor development for abstract concepts. In comparison to our approach, elastic metaphors seem to be most suitable to improve systems that already have a defined set of functionality. Instead, in the case of the research data platform, we focus on the generation of new metaphors and ideas for functionality.

For metaphorical design thinking, Logler et al.[20] introduce metaphor cards that help participants to use metaphors as "a tool for idea generation". They argue that metaphor cards should be "supported with contents that helps make metaphors concrete for participants" [20, p.1379]. The resulting cards contain concise information, and may be most meaningful in concrete projects, for example to focus a discussion and to brainstorm ideas in a narrow space. On the other hand, the approach may unintentionally minimize "conflicting accounts". These conflicting accounts may indicate differences in the model of participants, researchers and stakeholder (compare [10, p. 12]), and should remain visible. Thus, we decided to use the metaphors as openly as possible, asking participants to describe their own model of the platform.

Lockton et al. [19] provide a card set of metaphors, containing cards called *Things 1* (tenor) and *Things 2* (vehicle). *Things 1* cards describe, shortly summarized, the problem to be evaluated, and are not necessary if participants bring own problems to explore. *Things 2* cards contain a metaphor. The juxtaposition of a problem (or *Thing 1* card) and a *Thing 2* card form a "provocation in the style of Edward de Bono" [19, p. 323]. As a result of the workshop, Lockton et al. present new app concepts. While the *Things* cards contain fixed metaphors, we chose to work with metaphors generated directly

by the participants, which allow to discuss assumptions about the research data platform.

Jung et al. [13] discern three formal aspects, namely surface, behaviour and system, and their influence on affordances and user interaction. Similarly, we discovered aspects in the participants' metaphors used to describe the system. One metaphor, the research data platform seen as a favourite restaurant, explicitly addressed the experience the users imagined to have when using the platform, along with complementary functionality (recommendation system). For future work, it may be interesting to systematically analyze metaphors according to all three aspects by Jung et al. [13].

Hamilton [12], taking organization studies as an example, argues how the dominance of one metaphor in a discipline can lead to one-sided theoretical interpretation of a concept. Similarly, we aim to detach the concept of research data platforms from existing models, metaphors, and preconceived functionalities to develop new viewpoints.

Building on this knowledge, we demonstrate how metaphors can offer inspiration for the development of systems design. Especially in already digitalized environments, the metaphorical design process can offer cues to look for new behaviour, properties and functionalities that avoid the mere repetition of existing systems.

5.4 Metaphorical Design Process

During our practice of metaphorical design, we made a number of observations that may help researchers in the application of the process. In addition to the activities provided in the guidelines for metaphorical design [11], we identified two more processes in metaphorical design that we think necessary to consider separately. Therefore, in the following we discuss not only (1) the metaphorical design process, but also (2) the application of metaphors as a projective technique and (3) the application of metaphors as creativity technique. All of these processes seem to be closely related, and it may be necessary to reflect on their conscious application.

We applied the metaphorical design process to support problem setting and to identify new domains of activity. The approach to (metaphorically) see the research data platform as a botanical garden provided new viewpoints of the system to be designed. The variety of collected metaphors can be used as alternative models to open new ways to assess and explore digital resources in a research data platform. Metaphors do not need to be explicitly incorporated into the final system, nor need to be interpreted too literally. For example, using the botanical garden metaphor, the research data platform does not have to be green, display plants, or be outdoors.

In focus group discussions, metaphors can be helpful to describe unfamiliar concepts by resorting to already familiar concepts (compare Appendix A.1 for more information on projective techniques). In our case, this technique actively involves users already in the early stages of systems design, as metaphors allow to express ideas and expectations. To understand the users clearly, the chosen metaphors should be described by the participants themselves in a few additional sentences, eventually leading to bridging concepts. In the early stages of a project, the metaphors can add to the general concept of the system.

When using metaphors as a creativity technique, "seeing something as something else" can open new approaches and "accidental

entry points” necessary for lateral thinking ([6]). This way, the metaphors are interpreted rather freely, based on personal associations of the researchers. When using the collected material (input of participants) for inspiration, the original intention of the participants may be lost. This may be seen as a diverging-converging creative process, first moving away from the original material in the process of metaphor development (and, thus, from the participants), then preparing materials (e.g. concepts, layouts, prototypes) for further exchange in co-creation sessions (thus, approaching again). Therefore, it is important to continuously communicate with stakeholders and users, and to validate the results.

5.5 Limitations

Uncritical application of participatory design may lead to the wrong assumption that “working with the users” almost inevitably would lead designers to do the right thing” [4, p. 2]. To avoid that participatory design becomes purely instrumental, it is vital to acknowledge that different views and conflicts between participants and/or stakeholders may exist, and to reflect how to navigate them. In this regard, this paper falls short on a concrete intervention. Nevertheless, we made sure to leave space for alternating views by using the metaphors as a projective technique, and by making sure that everybody had a chance to have a say. Amongst other things, we used a round-robin format during metaphor generation and did not rate the metaphors in the workshop. We assume that stronger conflicts may arise as soon as decisions have to be made, and differing models have to be negotiated.

As another limitation, we want to mention the online settings. We took several steps to ensure participant engagement and motivation: We sent information before the workshop, and included additional information in the workshop itself. The duration of one session was kept to a bearable length for digital meetings, and included a break. We used formats that ensured all participants were able to participate, for example silent brainstorming for wants-and-needs-analysis, or a round-robin format during the metaphor generation. These formats were alternated with unstructured feedback sessions and group work, the latter guided by forms. Furthermore, breakout rooms provided a group space for participants.

6 CONCLUSION

In this paper, we discuss the application of metaphorical design for problem setting and concept development of a research data platform. When developing or introducing new systems, designers can still rely on existing, excellent technical solutions, when at the same time they have methods to systematically consider alternatives together with prospective users. Therefore, we propose a setup combining a participatory workshop with metaphorical design, suitable especially in already digitalized environments, and during the introduction of systems with a strong model. The collected metaphors point out participants’ models and assumptions, and help to reflect on new ideas that enable the new system to benefit from additional technological possibilities. With the adaptation of the metaphorical design process to fit this specific requirements, we hope to provide PD researchers with a new method.

In the project, our next steps will comprise the revision of the concept, as well as the development of layouts and prototypes.

Setting out from the collected metaphors and ideas, we plan to transfer the findings to the development of prototypical digital solutions. After that, we plan to present the results to the same group of participants, as well as to additional stakeholders and users.

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A RESEARCH METHODS

A.1 Projective Techniques

In the case of focus groups, Krueger [17] proposes projective techniques when participants may find it hard to talk about the actual topic of the conversation. As one possibility, he suggests to “creat[e] analogies” [17, p.74], which enable participants to draw on existing knowledge and assumptions to describe new ideas (very similar to metaphors). Thus, “several barriers of expression” can be circumvented [17, p.71].

A.2 Future Workshop

The Future Workshop technique was introduced by Jungk and Müllert to develop new visions for the future together with citizens. A Future Workshop has three phases: the critique phase, where participants formulate critique of an existing system, the fantasy phase, where participants design new visions of the future and where reality doesn’t play a role, and the implementation phase, where visions are put into practice (for more detail see e.g. Jungk and Müllert [14]).

A.3 Wants and Needs Analysis

This fast brainstorming method can be used with a group of users to collect user needs. To constrain the brainstorming to meaningful results, participants are asked to write down what *information*, *tasks* and *characteristics* a system should have. Designers need to be aware that the results are not complete, and that the users will need to have relevant experience (see Baxter et al. [2, p.357]).

A.4 Affinity Diagram

An affinity diagram is a quick method for the analysis of ethnographic data or, for example in this case, brainstorming results. When working with post-its, these post-its can be directly used in the sorting. Similar concepts are grouped, forming visual groups that can be identified and labeled (see Baxter et al. [2, p.363]).

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