Jessica Schoffelen, Selina Schepers, Liesbeth Huybrechts & Laura Braspenning

Making design representations as catalysts for reflective making in a collaborative design research process.

Abstract

The role of making may seem self-evident in a design context. However, in developing an educational design research course at the Media, Arts and Design faculty (Genk, Belgium), we observed that students tend to lose their focus on making when design and research are intertwined. This paper reflects on a research trajectory that explores how to support students in intertwining making and reflecting throughout the design research process. During this trajectory, we redeveloped design research methods that make use of design representations – i.e. field studies, insights, experiments, prototypes and so on – as a means to connect making and reflecting. Design representations possess informative and inspirational qualities. They are produced by designers to open up their design process and enable communication, collaboration and reflection with others throughout the making process. We will argue that combining design representations with structuring rules of play in a design research method and using these representations throughout the whole design process can improve collaborative reflection-in-action (Schön, 1983), or reflection-in-making, since it allows students to work in a more iterative manner. Illustrated by eight case studies, we describe how we recreated and evaluated a design research method, making use of design representations and structuring rules of play.

Keywords: design research method, design representations, rules of play, making, reflecting

Introduction to goals, questions and methodological approach

In this paper, we reflect on a research trajectory involving the development of a design research method for an educational context. Specifically, we have researched, applied and (re)developed this method in and for a design research course at the Media, Arts and Design faculty in order to enhance the students' interaction between making and reflecting during their design research processes. The students partaking in this course have backgrounds in graphic design, communication and media design, photography, television/film, film animation and product design. They are all in the third year of a Bachelor's programme in media, art and design. They form interdisciplinary design research teams to work out a specific design research project according to a given design brief (e.g. concerning the redesign of elderly care). Over the years we noticed that, although we teach students to intertwine reflection and making throughout the entire design research process, they tend to lose their focus on making while conducting research for a specific design brief. The students are often inclined to approach design research as having the following two phases: 'researching the issue' (being a reflective researcher) first in order to 'make things' (being a(n) artist/designer, finding a solution for a particular design problem as quickly as possible) afterwards. While doing so, they neglect the value of iterations, lack interaction between their reflective and making process and often fail in developing collaborative reflection-in-action (Schön, 1983) or reflection-in-making. In our research trajectory of dealing with this issue, we define 'making' as both making research data and its interpretations tangible during the design process (e.g. iterations) as well as making the final design output. With 'reflecting', we refer to reflections on research data, field studies and what was made within the design process. For the last five years, we have used the abovementioned design research course

as a space for exploratory and qualitative research, wherein we investigated how to tackle (1) the tendency to jump to solutions without engaging in iterations and (2) the dichotomous approach to making something on the one hand, and reflecting about the making process and its output on the other. To tackle these issues, we tried to answer the following question: 'how can design research methods support students or inexperienced designers to intertwine making and reflecting in their design research'?

In order to contextualise this research question, we claim that our research trajectory is built on several assumptions. A basic assumption is that designing in interdisciplinary teams can enrich the interaction between making and reflecting in relation to the design brief, development and output. Students and coaches from different disciplines learn about each other's ways of working, media and visions. The second assumption is that design representations are able to stimulate a mutual relation between making and reflecting. While there has been much written on the first assumption (e.g. Gold, 2007; Brickwood, Ferran, Garcia & Putnam, 2006), we think that the second assumption has not been fully explored yet and therefore needs grounding in theoretical and empirical research. Therefore, this paper will first describe our desk research, which includes an exploration of several existing design research methods that stimulate an iterative design research process wherein the acts of reflecting and making interact. This section starts with the argument that design representations have informative and inspirational qualities that enhance the interaction between making and reflecting among (interdisciplinary) members of design teams. We will critically examine design documentaries, rich experience communication and design games as design methods wherein design representations are used to inform and inspire.

Second, we will provide insight into our empirical research that evolved through eight case studies over seven years. This research involves the (re)development and evaluation of the following two design research methods that combine the interesting qualities (informing, inspiring and structuring) of the design research methods we reviewed in the literature and which address the specific goals of our research: (1) a performative tour and (2) 'MAP-it'. We will show how the (re)development and evaluation of the performative tour and MAP-it paved the way for an adapted design research method that uses design representations in playful ways. Although these methods are (and can be) used by professional design (research) teams, this paper concentrates on their educational qualities. In the empirical part of this paper, (several editions of) the abovementioned design research course at the Media, Arts and Design faculty and the MAKING conference (Making, 2012) in 2012 will serve as case studies for discussing and evaluating the design research methods. We will discuss the methods we researched and recreated during the process and how they relate to our desk research on design representations. We will evaluate them by (1) reviewing notes of our face-to-face interactions with the students during the research course; (2) looking at the student blogs and research reports in which they wrote their reflections on their research projects; (3) investigating the representations that were made and (4) discussing the method with the coaching teachers. Seven to eight teachers per year have been involved in the course since its inception, each coming from a different media, art or design program at the Media, Arts and Design faculty. These teachers are divided in duos to coach three to four groups of approximately seven to ten students throughout the entire course, which allows a close observation of the design research processes and collaborations between the students. We will conclude this paper with some reflections on the usage of the most recent version of the design research method for educational purposes.

Desk research: researching design representations that connect making and reflecting

In design research literature, design research methods that make use of so-called design representations are very well suited to connect making and reflecting in design research. To discuss the value of design representations, we begin by referring to Palmer (1978) who defines the term 'representation' as "(...) something that stands for something else. It is some sort of model of the thing (or things) it represents" (p. 262). Visser (2010) considers design to be constructions of representations or a process wherein representations are generated, transformed and evaluated. This evaluation often happens through the interpretation of colleagues or by assessing the representation against other references. Design representations are thus documentations, tangible manifestations of and reflections on research data (e.g. ethnographic material of users' lives, sketches, prototypes and so on). In that sense, they inform the design team by immersing them in the context that they are researching. At the same time, the term 'representation' suggests that they do more than inform; each representation is only one possible interpretation of the research and thus inspires a specific view on it. In a sense, these representations – as a very personal view of one designer or design team on a research context – defamiliarise and challenge designers to examine the research process at hand more in depth or in a different way. This sparks the imagination, which is important for broadening the design space and exploring possible design solutions (Westerlund, 2005). We will discuss the following two design research methods that explicitly use design representations and combine both their informative and inspirational qualities: (1) design documentaries (Raijmakers, 2007) and (2) rich experience communication (Sleeswijk-Visser, 2009). The third design research method that we will discuss, (3) design games (Brandt, 2006), will illustrate that, in addition to being informative and inspiring, rules of play add the quality of structuring to the design research process.

First, design documentaries are based on user research and use film to visualise users' lives. Design documentaries explicitly do not want to use film as a mere 'note-taking tool', registering users' everyday lives to inform the design team. Instead, they want to explore film as an inspirational tool for communication that inspires teams to make innovative designs. Raijmakers (2007) therefore uses documentaries to immerse his viewers in users' (everyday) lives and integrates a form of defamiliarisation in his films in order to inspire. The design documentary 'Storage and Clutter in the Home', for instance, is a series of short film clips on how people store and display things in their home. The film is shown from the viewpoint of the objects inside of a cupboard and depicts the participants talking about the things in the cupboard. The ambiguousness of talking about something unknown for the viewer leads to a feeling of defamiliarisation and thus fires the imagination. These qualities stimulate the immersion of the design team members in a project or situation, allowing them to reflect on it and inspiring them in the making process.

Second, in the research of Sleeswijk-Visser (2009) concerning rich experience communication of user studies, the same interplay between informing and inspiring is described. Sleeswijk-Visser concludes that in her approach the communication itself can take on several forms, including graphics, photo or film. More importantly, however, she argues that the communication should be rich. It should stimulate the designer to immerse her/himself in the life of the user. To achieve that, the representations should represent (defamiliarising) ambiguities for the design team to interpret, rather than straightforward and well-defined conclusions made by the ethnographic research team. Like Raijmakers' design documentaries, this allows a reflective design dialogue that is informed by everyday life but, at the same time, is inspirational and open for making and creating new possibilities.

Third, design games are workshops in which participatory design teams collaboratively develop design scenarios (representing users, desirable situations, technologies and so on) as a first investigation of possible design solutions (Brandt, 2006). These games make use of design representations (e.g. videos, photos or film stills made during user research) to playfully activate and enable scenario constructions by the design team whilst playing the game. Moreover, these games add rules of play that not only enhance defamiliarisation (offering a new view on the subject) but also structure the iterative process of making and reflecting. For instance, players are obliged to create 'stories' with the design representations – rather than mere incoherent fragments – or, alternatively, they have to elaborate on each other's input when creating new stories. These kinds of constraints are fruitful since they support exploration and reflection as the design teams iteratively create new steps in the design scenarios. Thus, in addition to their informative and inspirational qualities, design games add the quality of structuring to the design research process.

Empirical research: developing design research methods that connect making and reflecting

In this section, we will describe the following two design research methods that we developed which were inspired by the qualities of the design representations mentioned above: a performative tour (case study 1) and different variations on MAP-it (case studies 2 to 8). We will illustrate how these methods connect making and reflecting.

Case study 1: performative design representations

In the design research course in 2007, which dealt with the topic of elderly care, the students were asked to reflect on and make proposals for the users' life worlds (e.g. the elderly living in care homes). We explored two qualities of design representations (informing and inspiring) in a method, using theatre as representational form. In collaboration with a (local) theatre group, we organised a performative tour for the students through a residential care home. Over the course of five days, six actors collaborated with twenty staff members and residents of the care home. The tour was intended to be both informative – i.e. students walked through the home, immersing themselves in the life of the elderly – and inspiring, since 'real' inhabitants of the home and actors (reality and fiction) were intermixed in defamiliarising events. To illustrate, the performative tour went as follows:

> The audience had to participate in real-life situations from the everyday life of a residential and care home. (...) Each of the groups was left behind in the recreation area, where they were able to participate in a game of bingo. There was no end to the performance, and the audience finally had to decide for themselves when to leave (Janssen, 2007, p. 88).

Similar to design documentaries and rich experience communication, we aimed to inform and inspire our design students by stimulating them to immerse themselves and feel defamiliarised by the everyday life of a care home. We observed – both on the weblogs of the students (which they had to set up in order to make their design research process transparent) and from our face-to-face contact with them – how this approach encouraged reflection. This is illustrated by one of the students who, on his weblog, indicated that:

> As far as I am concerned they definitely succeeded in their aims; when the actors (?) spoke directly to us, you could see that the whole audience were thrown off balance, as if we were suddenly waking up together and realising that we were not just standing and looking from the sidelines. For many students this production was the trigger for a process of thinking about current questions in health care that would be continued during the workshops ... (Blog Nicky Sulmon, as cited in Demuynck, 2007, p. 79).

However, while the performative representations of field data were particularly suited for informing and inspiring the students during the performance, they did not stimulate students sufficiently to make new representations of their reflections afterwards. Rather, they considered this experience as their reflection and then immediately jumped to finding a solution and making a final design output. Since we aim to intertwine reflection and making in an iterative way (and not in a two-phase way, as described above), we looked for design research methods for the following year's course that give form to multiple iterations in a more structured way (comparable to the method of design games).

Case study 2 to 6: mapping design representations of fieldwork

Therefore, after using performative design representations, we explored a design research method that incorporates very explicit rules of play to structure the iterative process of making and reflecting. Inspired by mapping as an interesting form of making design representations, we started using this method in five cases, i.e. the design research courses taught in 2008, 2009, 2010, 2011 and 2012. Mapping allows the immersion of students in a specific research case by mapping the case in detail. Mapping enables them to analyse the issue in question while also creating and visualising data and/or insights. Mapping links two or more phenomena to each other and represents complex relations, activities, insights, interactions, processes and so on. While making a map, a designer has to select data (e.g. on the daily life of users) and turn it into something new. Mapping thus combines making something – temporarily, in between different design representations or as a final output – and reflecting on it.

We specifically made use of elements of MAP-it (Dreessen, Huybrechts, Laureyssens, Schepers & Baciu, 2011), a design research method that (at that time) was being developed by our research group Social Spaces (Media, Arts and Design faculty, 2013). MAP-it combines the principles of mapping with rules of play to activate reflective making in collaborative setups. MAP-it is a participatory mapping method and toolkit that visually represents participants, projects, processes, spaces, etc. (Huybrechts, Dreessen & Schepers, 2012). It can be used in workshops to collaboratively reflect on and/or make something (new), e.g. a design solution, a project plan or a workspace. MAP-it makes use of a background map representing the project; icons printed on stickers to visualise ideas and rules of play, including taking turns and using a colour for each group of players. Moreover, the so-called 'risk-stickers' which are incorporated in MAP-it introduce playful defamiliarisation in a collaborative process (see Figure 1). These stickers push people to share their opinions and give feedback by placing icon stickers on the map. One risky element, for instance, is a sticker of a bomb that corresponds to the obligatory step to 'bomb' something on the map. Observations of a former version of the MAP-it method (which, at the time, did not yet make use of these risky elements) showed that participants in a mapping workshop did not confront each other's perspectives and tended to move towards consensus rather quickly. Similar to the design games of Brandt (2006), after numerous mapping workshops the makers of MAP-it found that rules of play and risk-stickers trigger

defamiliarisation and are fruitful to structure explorative and collaborative reflective making. For instance, previous research showed that if the design research method is used for mere reflective means, few game rules can be used; if it is used to simulate reflective making, it is advised to integrate various game rules in the mapping workshop (Dreessen, Huybrechts, Laureyssens, Schepers & Baciu, 2011).

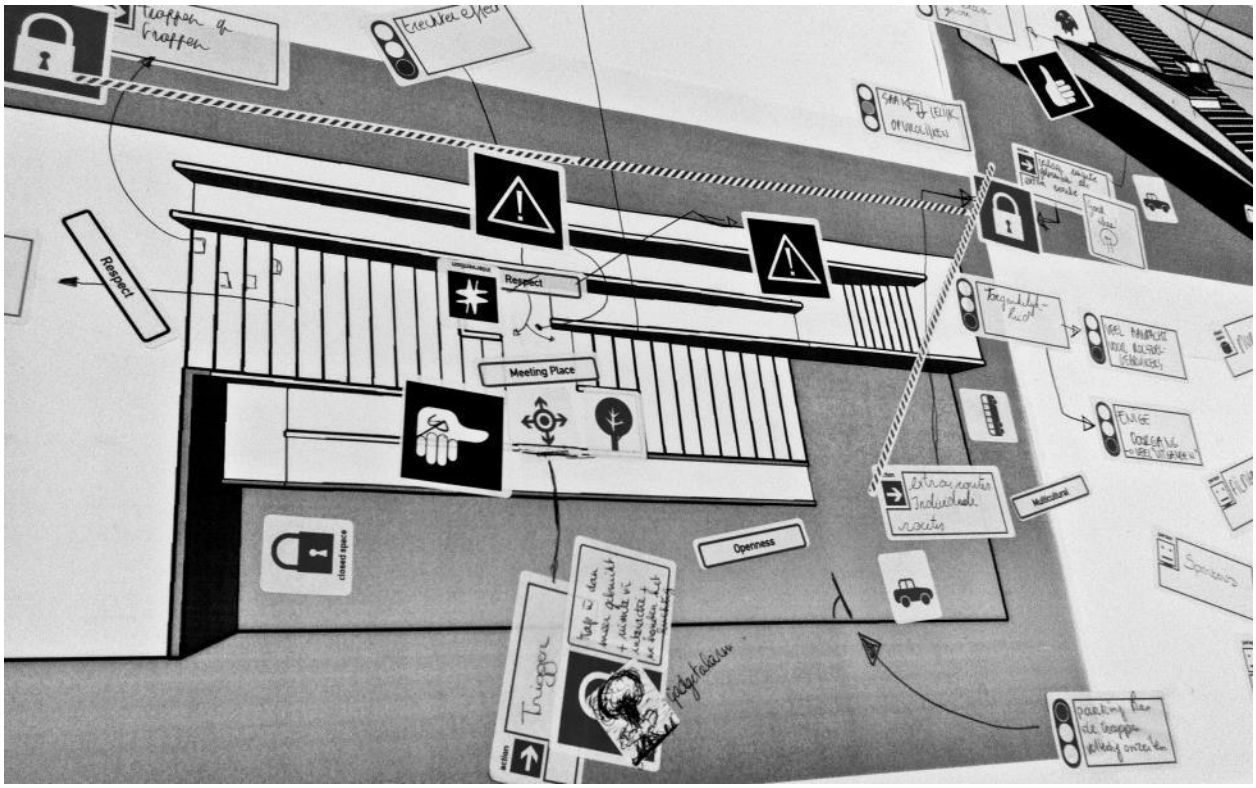

Fig. 1 MAP-it makes use of a background map, icons on stickers, rules of play and risky elements to introduce playful defamiliarisation and structure reflective making

For the 2008 design research course that concerned multicultural food culture, we asked students to map their fieldwork on food culture which they had conducted in the multicultural Belgian city of Genk. They had to explore the meanings that their fieldwork represented and use all sorts of media to visualise these meanings, insights and first ideas in an individual mapping. This resulted, among other things, in an audio mapping of how eating food with cutlery sounded during several eating moments in different families. To allow a reflective dialogue about these design representations within design teams, students communicated their reflections and insights to fellow students (i.e. their team members) and coaching teachers by collectively reworking their individual mappings into one collective mapping. The risk-stickers ('bombs', 'likes' and so on) were used to stimulate the students and teachers to take turns in evaluating what was on the maps. We wanted to stimulate them to further reflect upon what they made within the context of the design project and, in this way, support collaborative iterations in the ongoing design process.

We applied this mapping method again in the design research courses taught in 2009, 2010 and 2011. When evaluating the mapping method, we concluded that it structured the making of representations of fieldwork. The game rules of taking turns (e.g. each student

subsequently placed one element of their individual mapping on food culture on the collective map) and using different colours for different students (e.g. feedback placed on the map by one student could be distinguished clearly from feedback provided by another student) challenged the students to exchange approaches to their fieldwork and consider different viewpoints on the topic. Via these game rules, several design teams collaboratively made consecutive design representations (see Figures 2 and 3) by using the individual mappings as a starting point, which activated an iterative design process. However, not all of the design teams managed to make new representations as a team, based on their mappings. We believed that this resulted from the mappings being mainly focussed on representing and confronting the different views of the students regarding the fieldwork instead of the rest of the design process.

Fig. 2 Collaborative infographic for a project about public space

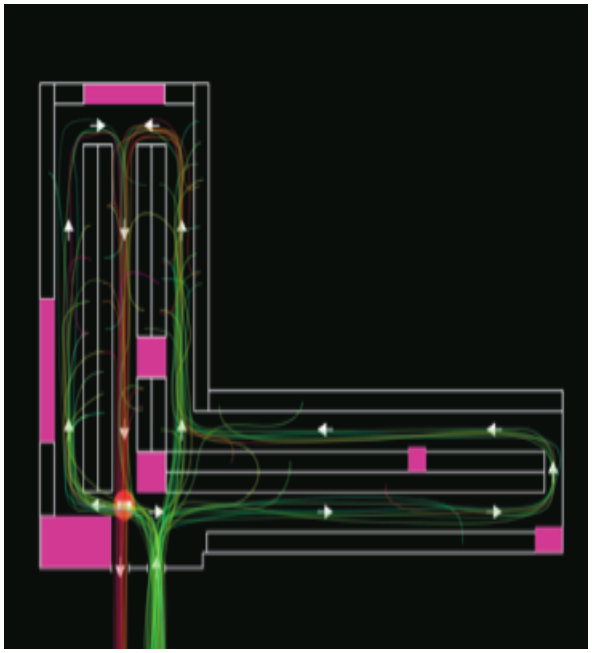

Fig. 3 Collaborative visualisation for a project about public space

Case study 7: mapping design representations of the design process at the MAKING conference

To further research this (i.e. the mappings being mainly focussed on representing and confronting the different views of the students regarding the fieldwork instead of the rest of the design process), we developed an approach to these mappings (as design representations) that focused on the whole design process instead of merely on the representation of fieldwork. We set up a test case for this new design research method during a workshop at the MAKING Conference 2012 in Notodden, Norway (Making, 2013) with a hybrid group of professional educators, designers, artists, researchers and one design student in order to receive suggestions and critiques regarding the approach from various relevant viewpoints (see Figure 4). Although this target group differed from the group in our design research course, i.e. educators and third-year students of a Bachelor's programme, we found the workshop to be a suitable first try-out to evaluate our new design research method for the design research course with an experienced and international group of designers, artists and educators. Similar to our design research course, the group of

participants in the workshop had various backgrounds, e.g. architecture, crafts and fashion. The evaluation of our method entailed a short investigation of the used format, game rules and so on, allowing us to adapt the method before introducing it to the students in our design research course in 2012, which dealt with the topic of the portrayal of the (future) elderly. The description and the evaluation of this empirical testing in the design research course of 2012 was presented at the conference 'Knowing (by) Designing' (Belgium) in May 2013 and can be consulted in its proceedings (Schoffelen, Huybrechts, Braspenning & Schepers, 2013).

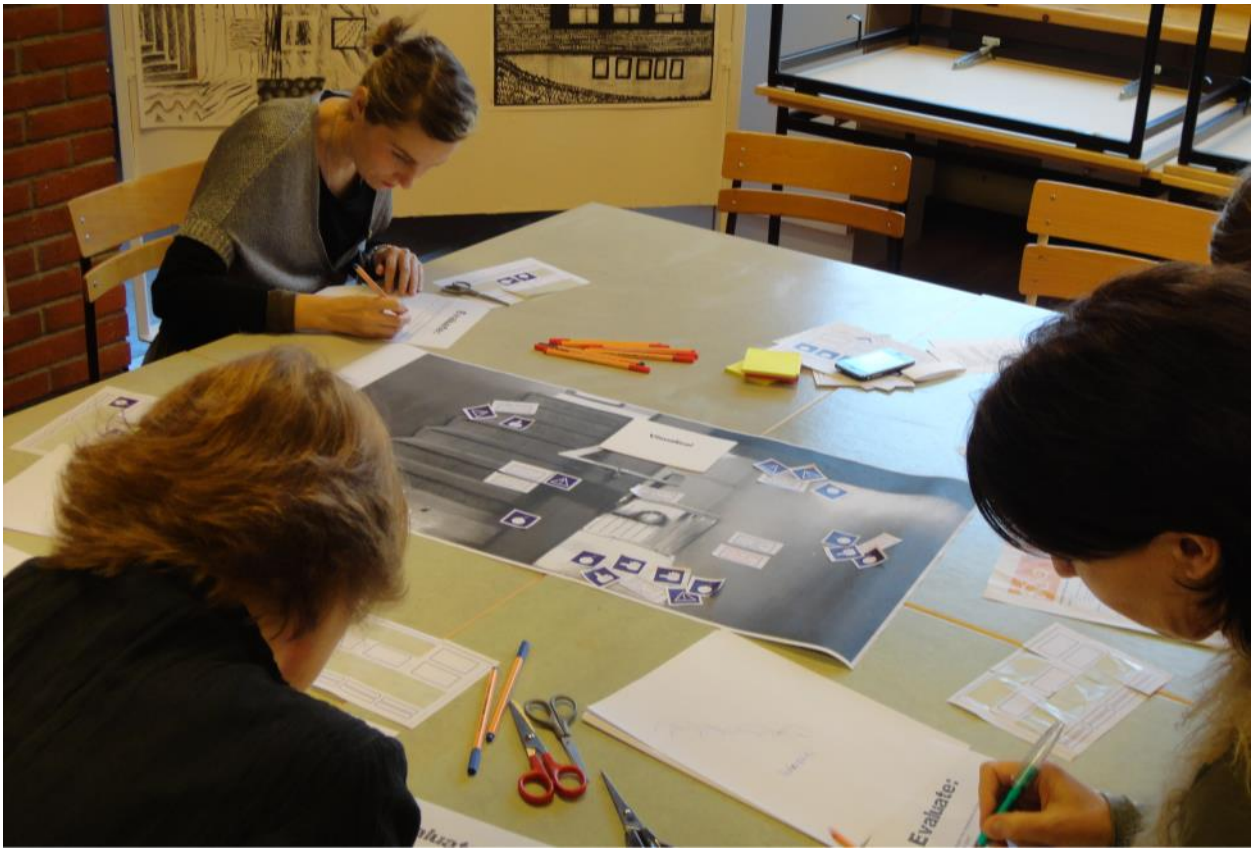

Fig. 4 Testing and evaluating the educational method at the MAKING conference

During the workshop at the conference, we showed the participants a design representation in the form of a short video clip that was made by our students during an earlier design research course on the use of public space. Nine participants were divided into two groups (one with five and one with four participants) to discuss the clip. The participants were stimulated in a playful way to collaboratively map aspects of the design representation and create a new design representation. The rules of play included the use of a background map that represented the video clip; the use of stickers to visualise ideas on the map; risk-stickers ('bombs', 'likes' and 'opportunities') and cards that depicted step-by-step instructions. A moderator guided the participants in each group through the process. The participants were given the following step-by-step instructions:

1. INFORMATION: what did you learn from the video clip? Map this.
2. INSPIRATION: what would you make with the video clip? Map this.
3. ADD bombs, likes and opportunities to the map.
4. Generate an idea using what is on the map.
5. Visualise this idea.

Each step had to be worked out within a short period of five minutes. We concluded the workshop with a discussion to evaluate the workshop's format and thus the design research method we developed.

- From the workshop, we learned that time is an important issue. The participants found that five minutes per step was too short to be effectively informed about the content of the design representation. The first two steps resulted in a minimal amount of results. Furthermore, due to the time restraint, the participants' observations and interpretations were too obvious. The following steps, which consisted of the idea generation and visualisation phase, seemed to be too short as well. We believe that allowing the participants more time will lead to a more in-depth and generative exploration. However, the participants also observed that the time pressure forced them to make decisions.
- The rules of play emphasising exchange and collaboration (taking turns, using different colours and so on) proved to be fruitful. Although participants did not know each other in advance, they nonetheless started talking about their backgrounds spontaneously (e.g. "Since I am a fashion designer, in my class I would …"). The visualising qualities of the mapping method created a shared platform between the participants from various disciplines while also ensuring that they did not stay in their own comfort zones. The participants believed that this confrontation made the ideas that were generated richer and helped them to see the topic from a broader perspective.
- The participants also explained that the playful 'risk-stickers' helped them to stay focused and provided them with a common ground for collaborative group work. They allowed the participants to work in a critical yet constructive manner. The participants mentioned that even though 'bombing' was not easy for everyone, it was productive since it forced participants to accentuate their argumentation. However, one person stated that the bombing phase took place too soon and killed potential ideas prematurely.

In general, the participants stated that the qualities of the new design research method restricted creativity. On several occasions, these qualities prevented constructive chaos and openings to new things. However, they also noticed that some of the qualities triggered iterations by elaborating on a design representation, thus stimulating the thorough exploration of design ideas.

Case study 8: mapping design representations of the design process at the Media, Art and Design faculty

Finally, we redesigned the design research method in order to help students to reprocess their design idea and elaborate on it more productively instead of jumping to solutions and consequently losing motivation to produce additional iterations in their design research processes. In this way, the design research method should support collaborative reflection-in-action (Schön, 1983). To test the redesigned method, we organised a mapping with the students partaking in the design research course in 2012 at the Media, Art and Design faculty. The course entailed design

research on the portrayal of the (future) elderly. By applying the method of mapping design representations, we wanted to encourage our students to communicate with each other (and with their coaching teachers) through design representations. More specifically, every student made her/his representation based on their fieldwork (an immersion in the life of one elderly person) and shared it with her/his team members via their blogs and through face-to-face contact. The students were stimulated to make selections and creative interventions in these representations. This representation of fieldwork informed the students about the design research and formed a basis for reflective making, as was the case in the performative tour described above.

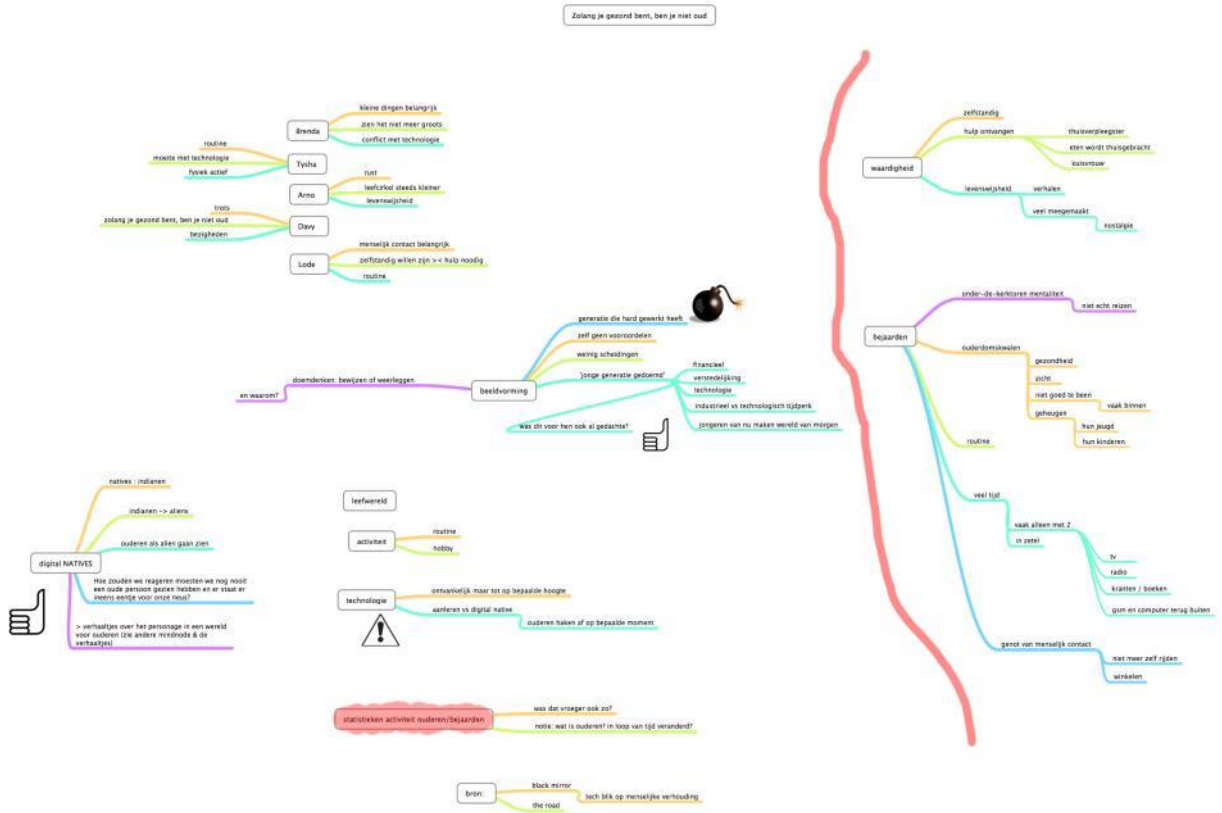

Fig. 5 Collaborative visualisation that shows how students exchanged their design representations and used rules of play in a collaborative making and reflection process

In the next step, team members exchanged their design representations and ideas about portrayals of (future) elderly people in live workshops sessions and via their blogs in order to inspire a collaborative making and reflection process. Rules of play were used to structure this. Communicating about each other's design representations through, for instance, risk-stickers stimulated a playful interpretative exploration and also enabled convergence (in order to make decisions); it thus stimulated (re-)making. Bombing something, for example, aided each team member in critiquing and elaborating on a certain representation (see Figure 5). The process of iterations was documented on each team's online blog to allow communication and reflection among peers and teachers. By documenting the process on a blog via design representations, the process gradually becomes transparent. This is illustrated by Mäkelä and Nimkulrat (2011) who

emphasise that by documenting the making process, reflection is triggered 'in' and 'on' action, thus inspiring making (Schön, 1983). This means that design representations can play a central role in the design process. They inform, inspire and structure an iterative design process, combining making and reflecting.

Based on our findings from case study 7, we adapted several aspects of the game rules.

- The game rules of taking turns and keeping track of time were slightly adapted in comparison with the previous case studies (case studies 1 to 6) in which we often experienced a lack of decision-making and, consequently, a lack of making. This hinders an iterative and reflective making process. Therefore, we gave the students in the 2012 course more than five minutes (learning from the workshop at the MAKING conference), but nevertheless limited the amount of time they had for each step. This put some pressure on the process and generated an ongoing workflow.
- We found that, for students, risk-stickers can be of great importance since they structure a design research process. From our previous case studies we learned that students often do not know how to move forward in a design research process. Because of the critique we received during the MAKING conference regarding the way that 'bombs' were used during the workshop, we asked the students in our course to 'like' things before 'bombing' other elements on the map. Also, we told the students to be more nuanced and present opportunities and alternatives when 'bombing' a certain element.
- The critique regarding how game rules can prevent creativity or creative chaos was countered in the 2012 design research course by discussing many different design representations. This resulted in more design openings and a greater amount of interpretations of the representation. This was in contrast with the MAKING workshop in which only one representation was discussed. Moreover, giving students more time to execute each step resulted in creative chaos and interesting surprises. We also included a game rule that instructs participants to 'switch maps'. A team member of the first team presents the collaborative map to a second team that can react to the first team's map and vice versa. This additional step of switching maps adds an extra layer of inspiration and stimulates creativity (Dreessen, Huybrechts, Laureyssens, Schepers & Baciu, 2011) by allowing constructive chaos in the mapping process.

Discussion and conclusion: learning from design representations

In this paper, we described a research trajectory that was inspired by a problem we encountered in our design research course at the Media, Art and Design faculty. We consider 'making' and 'reflecting' as two intertwining core activities in each design research project. However, we experienced that students either tend to lose their focus on making during a design research project or separate the reflective phase from the making phase in a two-step approach in which they reflect first and make afterwards. Therefore, we started to explore design research methods that support the intertwining of making design representations and reflecting on the design issue at hand within a design research course. Our approach consists of two basic assumptions. First, we allow students to experience a design research project in an interdisciplinary setup by working in teams with students coming from different academic backgrounds. Second, within this collaborative setup, we introduce design research methods that stimulate informing, inspiring and structuring via playful design representations. While the value of interdisciplinary setups is well

known (Gold, 2007; Brickwood, Ferran, Garcia & Putnam, 2006), the combination of these three qualities (informing, inspiring and structuring) in design representations to activate student teams to engage in a reflective making process has not yet been studied thoroughly and forms the focus of this research.

In this section, we discuss the value of our approach to design representations in relation to the abovementioned goals more in depth. Mapped design representations, combined with rules of play, (1) allow communication among peers (e.g. members of the design team) about data and insights that are based on real life in collaborative setups. This informative exchange allows collaborative immersion in the research topic. However, these design representations are not mere factual representations of research data; they also (2) add a different, unfamiliar view to the design research process and encourage interpretation. As previously mentioned, we used game rules (e.g. risk-stickers or switching maps) to help inexperienced designers (i.e. students) to let go of the urge to design a finalised end product or 'solution' as soon as possible. By combining our use of representations with game rules and using design representation throughout the whole design process (and not only in the beginning), (3) we structured the students' iterative reflection on the design representations and stimulated them to make new design representations. It is important to mention here that we are not searching for mere consensus within design teams. We have found that differentiations in teams can arise naturally by iteratively designing representations. This feeds a critical and reflective approach amongst team members and encourages students to approach making representations of reflections and insights as an intertwined activity.

We learned empirically (from our case studies) and theoretically (by doing desk research on design representations) that combining the three qualities of informing, inspiring and structuring in the use of design representations can playfully guide students through a collaborative and iterative reflection-in-action process (corresponding to the two types of reflection that Donald Schön (1991 [1983]) distinguishes, i.e. reflection-in-action and reflection-on-action). However, we must acknowledge that design representations often are used differently in a professional context than in an educational context. We thus distinguish between how design representations are described in the literature (mainly for a professional context) and how we apply them in our educational context (our empirical findings). The four main differences are visualised in Table 1. With respect to the design research methods mostly used in professional setups, design representations represent users' lives or field studies and are made by researchers, social scientists or designers in order to inform and inspire the design team. The design representations are often used within the first phase of a design process in which ambiguous representations can stimulate divergence. In contrast, we want the student designers to make these representations throughout the *whole* design process since they experience more difficulties with iteratively combining making and reflecting. The representations are visualisations or tangible manifestations of field studies *and* of ideas that arise during the design process. In other words, they represent the design and its process, thereby giving students a deeper insight into the development of their ideas. We want to allow designers to take the lead in representing (by visualising or making tactile) field data and design decisions throughout the whole design process. This more explorative approach to design representations fits the way designers work, following the idea of Cross' (2006) 'designerly ways of knowing'.

Table 1 Classification of current use of design representations and our proposition on how to use them

rich design representations	**literature study**	**our proposition**
representation	representations of field study	representations of the design process
maker	user researcher or designer	designer
design phase	first phase of the design process	throughout the design process
goal	communicate to design team	communicate to themselves and peers
qualities	informing, inspiring	informing, inspiring and structuring

To summarise, design representations are documentations, visualisations and tactilisations of insights which are made by the designer and/or the design team to communicate about knowledge and ideas. Design representations emphasise making and allow information and inspiration during the design process. They thus stimulate reflection-in-action (Schön, 1983). However, they are mostly used in a professional context, where they function as representations of users' lives that a researcher makes in a first exploratory design phase to immerse her/himself in a context (informing) and as defamiliarising inspiration for design teams. Because students need more structure in giving form to the iterative process of making and reflecting in design research, we proposed to use these representations throughout the whole design process as representations of design, i.e. field studies, insights, experiments, prototypes and so on. These representations are made by designers and enable interpretative visual communication, collaboration and reflection with others. To enable design representations to function in this way (as representations of design), we combined the informative and inspirational qualities of design representations with the structuring qualities of rules of play (inspired by design games) that guide students in using design representations throughout the whole process, rather than just in the beginning. In the course of eight case studies, we refined this design research method of playfully mapped design representations so it could function as a good catalyst for reflective making in an educational context.

Jessica Schoffelen
PhD student/lecturer
Social Spaces, MAD-faculty, UHasselt
jessica.schoffelen@khlim.be

Selina Schepers
Researcher
Social Spaces, MAD-faculty, LUCA/
Faculty of the Arts, KULeuven
selina.schepers@khlim.be

Liesbeth Huybrechts
Lecturer/researcher
Social Spaces, MAD-faculty, LUCA/
Faculty of the Arts, KULeuven
liesbeth.huybrechts@khlim.be

Laura Braspenning
Lecturer/researcher
Social Spaces, MAD-faculty, LUCA/
Faculty of the Arts, KULeuven
laura.braspenning@khlim.be

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