

GENERATING DESIGN CONCEPTS: A PROPOSAL TO UNCOVER THE BLACK BOX

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ABSTRACT

Design concepts is an important part of design education, but the term “concept” is used in a variety of different, sometimes confusing and conflicting, ways. Concepts are often defined as a rough sketch, a prototype, or a set of properties that the possible artefact should contain. In literature, many different interpretations can be seen in existing methods for generating concepts, which do not guide students to create abstract concepts with different levels of abstraction and use them to guide the creation of many possible artefacts. The paper viewed the gaps in the existing methods as a black box. By shedding lights on this black box, the paper aims to propose a step-by-step concept generation method, which can guide students to generate abstract concepts with multiple possible outcomes. The proposed method is iterated and tested with design student groups in two pilot runs, which indicates positive experiences and outcomes. The paper claims that a design concept is an abstract entity and defines a core idea, and is a guiding tool for how to design artefacts.

INTRODUCTION

In the design process, concept generation plays a vital role in creating and developing novel products or services. In design education, it is important not only to teach students how to make and create artefacts, but also to teach how to communicate core ideas guiding the making of the artefact. These core ideas are often called *concepts* (Nagai et al., 2009).

As a teacher, it’s always nice to look at artefacts created by students with nice finish and with skilled craftsmanship. But to evaluate if student’s artefacts are good solutions to a given problem – that’s completely another story. The answer must many times be: “It depends”. It depends on the prerequisites such as: “What is the design problem?”, “Who are the intended users and stakeholders?”, “What are the coming trends?” etc. A good solution to a given problem is also depends on the number of ideas students generated to build their artefacts and how well these ideas are communicated. If the artefact is just presented “as is” with no explanation, then one of the questions as a teacher therefore might be: “Is this artefact just an isolated one off or is it possible to use the idea of the artefact in other situations?”. There is a big difference if the artefacts are built by “silent hands”, with no explanations, or if the artefacts are communicated as the outcome of a core idea, a concept. If the latter is the case it should be possible to use the created concept as a catalyst or DNA to be reused and enable the generation of a variety of artefacts suitable in other contexts. The world famous design of armchair, “The Egg” by the Danish designer Arne Jacobsen in 1958 (see Figure 1) is an example from the real world when the idea and the abstract construct can be reused to create more than one artefact.



Figure 1. The armchair by the name “The Egg” made by the Danish designer Arne Jacobsen.

Arne Jacobsen has also created a footstool suitable for the armchair. He has probably reused the same concept, by using an egg as an analogy as shown in figure 2:



Figure 2. The footstool belonging to the armchair “The Egg”.

To make an appropriate footstool the designer might have separated between the artefact (i.e. the physical armchair), and the idea (i.e. the metaphoric idea of an egg), to be able to transfer the same concept to the footstool (see Figure 3: 1-2-3A+B). That is artefacts that we know was created from the concept the egg. But is it possible to create more artefacts from the same concept? For example one could design a vase of glass, based on the concept egg. Or one might use the concept in other domains than furniture. What would a swimming pool look like, or a cabin, or what would a deep water craft look like based on the concept egg? (see Figure 3: 3C).

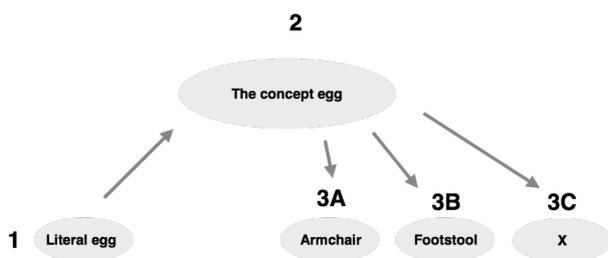


Figure 3. (1): A literal egg has some characteristics, some of them are abstracted and metaphorically transferred to (2), the concept egg. From the concept egg an armchair can be materialized, (3A), and the same concept generates a footstool, (3B), and last but not least: (3C) where “X” stands for a variety of possible outcomes from the concept egg, in the domain of furniture or, in other domains.

“The art of travel” is another example of a design concept. It was created by Louis Vuitton - one of the most successful brands in the world, in the late 1990s (Soloaga and Guerrero 2016). The concept *the art of travel* are corresponding to the history behind the brand which started in the mid nineteenth century when the company started to sell trunks suitable for travellers going by train. Today, based on the concept, *the art of travel*, the company offers a wide range of products for a variety of commodities, like: shoes, diaries, pens, umbrellas, and others products (louisvuitton.com). The products Louis Vuitton are offering are not necessarily useful when travelling, they rather adhere to the *idea of the art of travel*. The concept is not to be taken literally. It is a metaphor and thus it is to be understood metaphorically. Louis Vuitton’s design concept can not only be seen in their range of commodities it can also be seen when the metaphoric meaning of *the art of travel* is transferred to the company’s market communication, for example, a media mix containing visual communication depicting many aspects of *the art of travel* with imagery of planes, balloons, exotic places, couples in love travelling, and so on. In the future it is possible that Louis Vuitton can be guided by their core design concept, *the art of travel*, to generate new solutions to cope with changes in market, media, and technology.

The art of travel is also a good example of how an abstract concept as a core idea can be applicable to different situations e.g., for using in different forms of media communications, or for generating a range of different products and services. Louis Vuitton do not restrict the concept *the art of travel* to a single product, the company rather use it as an enabler (or guiding tool) for creating a range of products and services. Accordingly, a concept is an idea and a framework of what to make in general and a good concept should be easily applicable in different situations, giving birth to multiple artefacts in various context. Such an approach of generating concepts can be important when teaching students in design education. But for students to separate between artefact and abstract ideas, as concepts, is sometimes confusing due to having many meanings of the term concept. The term concept is ambiguous and of multiple origins. The following is stated in The Oxford English Dictionary:

- “a general idea or notion, a universal; a mental representation of the essential or typical properties of something, considered without regard to the peculiar properties of any specific instance or example.”
- “An idea underlying or governing the design or content of a product, work of art, entertainment, etc.”
- Historically the word has meant, “A draft or rough copy of a letter, official document, etc.”

In this paper it is essential to bear in mind that when talking about concepts we mean the first two interpretations: concepts as a result of abstraction created by the mind, and we do not propose the possible historical meaning in which the term concept can be addressed as a rough copy or other artefacts. The concept of concepts and the ambiguous meaning of the term concept is a maze that is also easy to spot in design literature. There is no unified common definition of concept (Nomaguchi et al., 2011). This can be seen in many ways:

- Very common is use of the term concept without explaining *how* it is used. See for example Andrew (2007), Baillie and Benyon (2002) and Lund and Tingström (2011)
- Another way, as mentioned, to use the term concept is the meaning of a sketch. See for example Nomaguchi et al., (2011)
- The concept is interpreted as some chosen properties. See for example Li et al., (2012)
- Another way to interpret the term is as “solution principles”. See for example Valentine (2012)

Another problem is that in design literature, analogies (Dorst and Cross, 2001; Goldschmidt, 2001; Howard et al., 2010), metaphors (Holyoak and Thagard, 1995; Hofstadter, 1995) and concepts are often described as a quite similar phenomena and compatible with each other (See for example Ogilvie and Liedtka 2011).

The, sometimes conflicting, interpretations of the term concept should not stand in the way of the possibilities and need to use it as an abstract idea and not as an initial concept development phase “in which the product principal properties are defined and the product is given a first initial shape” (Valentine 2012 p. 2). Instead, concept development as a comprehensive tool in product development can however offer much more possibilities than what is commonly known and presented in literature (Valentine 2012).

The many interpretations of the term concept can also be seen in the various models and methods for generating concepts. This depends on what criteria the authors use for the term both explicitly or implicitly. The extension of that makes the creation of concepts in many cases, as if, they were made in a *black box*. Black box is here defined as the scientific term when the internal mechanisms or the structures in a system are ignored and only the correlation between stimulus and response are investigated and checked. You don’t care what’s happening inside the box, you are just interested in what goes in and what goes out of the black box. So, in the existing methods for generating concepts – what do we mean is the black box and not exposed? The area not fully covered by existing methods is the part of abstraction. Sometimes, but not always, the prerequisites for the design are conveyed but all of a

sudden a solution is created, like in a black box, and that is a research gap. The existing methods in research and education are not explicit and they don’t go semantic on what in the design problem is abstracted, and what is the optimal level of abstraction for an abstract concept to guide the solution(s). That is, all the different parts do definitely exist in literature, it’s just that they are not put together in a coherent method. For example, Hey et al. (2008) used the combinations of metaphors and analogies, and Goldschmidt (2011) as well as Höök and Löwgren (2012) used the combinations of abstraction and metaphors. And as design teachers, we believed that it is helpful to teach students how to use, and reuse, the same concept in different situations. Specifically, during teaching a need was felt for methods to make the students not to prematurely start creating artefacts without research and elaboration with the design problem. Moreover, we wanted to be sure that students are able to separate between artefacts and the ideas behind the artefact. However, as stated, there is a lack of methods with these qualifications to be found in literature. Hence, there is a need for a generic method for students which is not only fit for one-off solutions, but also for multiple possible outcomes. The aim of this paper is therefore to propose a step-by-step generic *concept generation method* (CGM), which can generate abstract concepts with multiple possible outcomes.

Research METHOD

Mälardalen University offers courses in design education at bachelor, masters and doctoral level of education. Some teachers in the university have been teaching elements of generating design concepts for more than a decade. It is obvious that there is a gap between the need for the students to learn how to generate design concepts and the available methods to do that. To address this gap, research was conducted in four following phases as shown in Figure 4:

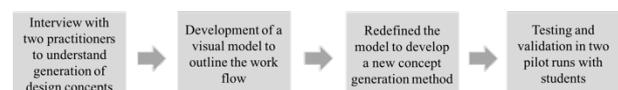


Figure 4. The four phase research process for the study

In the first phase, semi-structured interviews (Yin 2009) were conducted with business consultancies who have been working and supporting various companies on the concept generation related to the service design for understanding how practitioners can generate design concepts. Since the study has an explorative nature and has limited knowledge on the subject (i.e. how to create abstract concepts with multiple possible outcomes), a qualitative interview method seem to be appropriate for the study. The two interview informants had job roles as a senior designer and a service designer. The interviews were based on open questions, with a few selected themes.

The consultancies have structured ways of working with the design process in general but they don't have a structured method explicitly for generating design concepts. But one of the practitioners told about a case from Systembolaget, a alcohol monopoly with a nationwide retail network in Sweden, where it was possible to see a structure, even if the practitioners did not call it a structured method.

A couple of years ago Systembolaget had decreasing customer satisfaction index (CSI). That was a major problem for the government controlled organisation because their legitimacy depended on Swedish citizens to vote for politicians who like to keep the alcohol monopoly. The business consultancy, to whom the assignment was given to improve CSI started to analyze the problem. They found that even though Systembolaget had very educated staff with good knowledge about their products who sold thousands of products in their stores, the staff worked like warehouse workers. There was not much room in the store to give service and product related information to customers. That was some of the attributes the consultancy found doing research about the problematic situation. However, consultants found an occupation in another domain where it is a jobrole to inform customers about alcohol, giving advice about what to drink to certain foods, what to drink at certain occasions etc. That occupation was sommelier. So, the business consultancy's proposed a solution the design concept, that is, the staff should work as if they were sommeliers in a metaphorical sense when giving service to customers. The outcome of the concept was that customers were instantly happier and CSI rose in a short span of time. Consequently, the positive side effect was that the staff appreciation of their work rose even more. After two interviews, data shows that consultants used metaphor as a concept. The lead author of the paper has been teaching concept generation more than a decade. It was felt that data was enough to build a visual model or at least a first prototype to test. Hence, in the second phase, based on the interviews and observations, an outline was made to structure the business consultancy's work flow in a visual model, as shown in Figure 5.

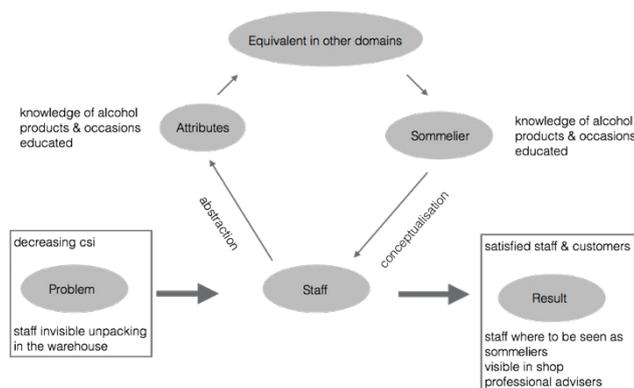


Figure 5. The first developed visual model of workflow of concept generation based on the the business consultancies.

As illustrated in the figure, the consultancy identified a problem that could connected to decreasing CSI by abstraction and focusing on certain things by abstraction. Attributes found was that staff had good knowledge of alcohol. The business consultancy found an equivalent in another domain. There was another profession with good knowledge of alcohol, sommeliers. The conceptualization was that staff should, metaphorically, work as sommeliers. The result was an immediate increase in CSI and as a bonus, even greater rise in satisfaction among Systembolaget's staff.

In the third phase, the model in figure 5 was redefined based on the theories related to abstraction, metaphors, and analogies. This is because the model in figure 5 does not show different situations or contexts, and hence it cannot be generalized as a method for generating concepts. In order to develop a generic approach, there is a need of a method, where the artefacts created are the embodiment of an abstract design concept. Hence, the new modified concept generation method (CGM) was developed based on both the work of Louis Vuitton's concept and the concept of Systembolaget. The art of travel is the design concept and the commodities on the market is the outcome and a context for the embodiment of the concept. Media is also a context for the embodiment of the abstract design concept which is seen in images, ads, and so on. Finally, in the case of Systembolaget, the embodiment of the abstract design concept, i.e. sommelier, was a process, that is a guidance for how the staff shall work.

In the fourth phase, the new CGM was tested within the design education environments. The first pilot was tested with more than 300 master program students in more than 30 groups in March 2017 at three business schools at different locations in India. The pilot included a series of lectures and workshops about design thinking and generating design concepts. The lectures and workshops were given in the length from one hour up to two days. All observations were documented with field notes, and photos of different design concepts created by students on whiteboards. In the second pilot, four students from the master program in innovation and design at Mälardalen university participated in a three hours workshop working with the design concept generation method in September 2017. First, an open ended discussion was performed after the workshop by asking following questions:

- What are the benefits of working with the design CGM?
- What were the challenges with CGM?
- Have you before been working with other models?

After the discussion, the students were given a survey questionnaire with 10 questions. Each question was graded on a five point Likert scale where 1 means "Disagree" and 5 means "Agree completely". In a free text part of each question, students could clarify and

explain answers/choices in a detailed way. The aim of the survey was to identify the student perception on the new CGM and its relevance in design education.

THEORETICAL BACKGROUND

In the reviewed concepts the armchair's *the Egg*, Lous Vuitton's *the art of travel*, and Systembolaget's *sommelier* we can see common ingredients such as problem, abstraction and metaphors (interpreted in the terms broad sense) to create abstract generative concepts with the ability to guide the making of multiple artefacts in one, or more domains. Hence, the theoretical background is explained in relation to key aspects of the first prototype and model described in Figure 5, which consists of Problem, Abstraction, Metaphors, Concept, and Result

Problem: The term *design thinking* is vague and ambiguous and a collection of concepts. It can be seen both as a mind set and as an approach to creative problem solving as well as a multitude of methodologies and generic processes. *Design thinking* is used in theory and practice and occurs both in the discourse of design and that of management. Despite the widespread use of the term, quite a few design researchers claim that there is still a lack of empirical research on design thinking (see for example, Wetter 2011, Johansson-Sköldberg et al., 2013, Carlgren, Elmquist et al., 2016, Carlgren, Rauth et al., 2016). The method to be created in this paper, CGM, fits well within the discourse of design thinking in the sense that design thinking is about not taking the problem for granted in a process of constant framing and reframing (Schön 1983). Rittel and Webber (1973) and (Carlgren, Rauth et al. 2016) makes a distinction between lame-, and wicked problems. Lame problems are constituted as a set where the problem-solver can gather necessary information for understanding and solving the problem. Wicked problems, on the other hand, are not that easy to define and grasp. For example, Rittel and Webber (1973) identified wicked problems in planning in nearly all public policy issues, such as planning for roads, tax rates, fighting crime or modification of school curricula. Those problems must be seen in a context and the search for information to understand the problem, is dependent on some kind of idea of a solution. This means the problem and the solution are communicating vessels dependent on each other. Rittel and Webber (1973) arguments has implications for the design thinking process. Pacanowsky (1995) argues that wicked problems by necessity must be iterative - "as we cycle through the phases of problem definition, information gathering, solution, and outcome" (p. 37). Liedtka (2015) also claims that the design thinking process as such could be constructed as a wicked problem because the "problem" can differ so much depending on complex contexts.

Abstraction (Attributes in figure 4): Welling (2007) views abstraction as a tool for creativity and prerequisite for many mental operations such as classification, generalisation, pattern recognition etc. Abstraction is often claimed to be imperative for novel and creative design because a concrete artefact, in lack of abstraction, can only be used for the specific situation it was intended (see for example Höök and Löwgren 2012). Root-Bernstein (1991) gives a simple example of abstraction - a smiley (see figure 6), where some features are isolated and some features are exhibited by the simplest means from the human face.



Figure 6. A smiley is an example of abstraction from a human face.

Paton and Dorst (2011) studied communication between professional designers, and clients and other stakeholders. They identified the use of abstraction as a tool to avoid fixation and to move away from the initial frames in a design project towards a mutual common understanding. One of the tools, of abstraction, they found in their research was "tone". The tone in design relates to "what people read without reading", the "feeling" in a song or the impression of a photo. One can also call it look-and-feel of artefacts. It is important in design projects to work with the desired tone in a project. One example of tone and desired value in a design project was when a major Swedish bank some years ago created on a website, not ordinary instruction films, but more like economy and finance news on TV without mentioning the brand name. Because the bank claims that they don't deal with marketing, and their customers don't have a demand for commercials (internetworld.idg.se 2014). In that sense the bank provides the "feeling" of objective economy- and finance news instead of marketing and commercials.

In the discourse of design and abstraction it is common to refer to "levels of abstraction". Lower levels of abstraction means concrete and specific, and higher level of abstraction means more abstract and some kind of generalisation. An example is seen below in the model by Hofstadter (1999), going from high level of abstraction (1) to the very concrete specific level (6), see Figure 7.

- (1) A publication
- (2) A newspaper
- (3) The San Francisco Chronicle
- (4) The May 18 edition of The San Francisco Chronicle
- (5) My copy of the May 18 edition of The San Francisco Chronicle
- (6) My copy of the May 18 edition of The San Francisco Chronicle as it was when I first picked it up (as contrasted with my copy as it was a few days later: in my fireplace, burning)

Figure 7. A visualization of abstraction by Hofstadter (1999)

Metaphors (equivalent in other domains in figure 4): The term metaphor means pairing two domains, like in the sentence, “Life is a river”. We call river the “source” and life is the “target”. Often the source is something concrete and the target is something abstract like the abstract concept of life is explained by the concrete concept of “river”. Metaphors is not a matter of figure of speech but rather a figure of thought. When you “see” something as something else it’s a figure of thought (Snodgrass and Coyne 1992). One example of such a mental operation is seen in the sentence “My lawyer is like a shark”. Some attributes from the source are carried over to the target and others are abandoned. The literal shark has gills and swim in the ocean etc., attributes never transferred to the metaphorical shark. Carried over attributes are like viscous, predatory, aggressive, which can be applied to a lawyer (Glucksberg 2008). Glucksberg (2008) also refers to research indicating that metaphors can be interpreted as more than the sum of two domains. In the sentence, *some ideas are like diamonds*, where the interpretation can be that some ideas are brilliant and insightful and some ideas are fantastic and creatively unique, are clearly not included in the original metaphor.

According to Casakin (2006) using metaphors in the early phases of design both gives the designer a starting point and enables different points of views. This helps reorganizing experiences in a process of reframing. Altering metaphors can utterly change the appreciation of the problem at hand. Metaphors can also help designers to explore remote knowledge domains to be able to move away from, and not stay in the domain of their expertise. Furthermore, metaphors can be used in different stages of the design process. Casakin (2006) also concludes that using of metaphors in educational purposes can enhance students design thinking capabilities and understanding of the design process, improving both innovation and critical design abilities. Metaphors will also give novice students a framework to develop own ideas and their skills in design problem-solving. An example of a metaphor used in architecture is the world famous Sydney Opera House, which was designed to look like the movement of a vessel in the sea.

Concept (Sommelier in figure 4): The model created by the visualisation from the consultants case with Systembolaget shows the actual outcome of the concept, sommelier. To be able to create a method helping students to generate design concepts the term *sommelier* in the first prototype was later replaced with the generic term *concept* (see figure 8).

MacInnis (2011) describes a framework for conceptualization in marketing. She defines conceptual thinking as a process of understanding a situation or problem abstractly: identifying patterns, connections and key underlying properties, which demands

divergent thinking skills. MacInnis (2011) also exemplifies how metaphors and conceptualisation can be used by referring to Gareth Morgan’s classic book, *Images of organisation* (Morgan, Gregory et al. 1997) in which new metaphors for organisations are presented, such as, machines, organisms, brains, cultures etc. MacInnis’ (2011) concluded that conceptualising moves the scientific field of marketing forward and that students should be taught in conceptualising thinking skills. Höök and Löwgren (2012) introduces what they call “strong concepts” in the field of interaction design. Strong concepts are defined as generative, core design ideas, transcending particular situations and application domains. The authors also conclude that Strong concepts also foremost possess a high level of abstraction. They also give an example of a strong concept, that is, social navigation, where one makes decisions based on the decisions of others.

Result (staff in figure 2): Abstracting a concept from a particular situation enables generalizations, and allows the concept to be applied in more than a single situation (Schön 2013). The model in Figure 4 created from the interviews shows how the concept was applied on Systembolaget’s staff. That is one situation, or context where the concept can be applied. This model was modified and redefined as a new concept generation method (CGM) as shown in below figure 8 in the next section.

A CONCEPT GENERATION METHOD: A PROPOSAL

Figure 8 illustrates the proposal of a new concept generation method, including five key steps, namely, problem, abstraction, metaphors, concepts, and solution. Five steps in the method contains sub-steps which are referred as A and B.

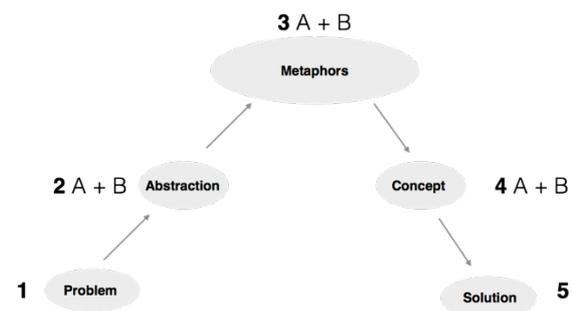


Figure 8. A modified visual model of workflow and the proposed CGM

The first step is identification of a **problem**. Here, one has to choose a domain, or a sub-domain of the design problem at hand. The second step is **abstraction**. Here, one has to look at different properties associated with chosen domain (2A). The properties include attributes, function, and tone. Then check out different levels of abstraction (2B).

The third step is **metaphors**. First sub-step is to look at the properties from the abstraction (3A). Users has to question themselves: Is it possible to find any patterns of properties that would fit to an equivalent in another domain? Then check out different levels of abstraction (3B).

The fourth step is **concept**. First sub-step is to give an example of at least one artefact possible to create with the guidance from the concept (4A). Then, one has to simulate how chosen concept is feasible in different situations in areas such as media, processes, and products (4B).

Finally, the fifth step is **solution**. To be able to communicate the concept to stakeholders, the concepts implications must be defined: what is the concept, and what is not the concept. That can be done by just stating two or three terms of what is included in the concept and two or three terms of what is excluded in the concept.

TESTING OF THE CGM MODEL: PILOT 1

The first pilot on the CGM was resulted into few interesting design concept generations by students, as shown in Figure 9. The left image is a description of a restaurant driven by the concept “Childhood memories”, with some implications, the restaurant, for example, should have: old snacks, handheld video games, and desserts like candy floss and so on. On the image of the right side there is a visualization of the concept that a teacher has the attributes of being well educated and with vast experience and can be seen is an “architect of students future”. In that sense the teachers are making “building blocks for students future”.

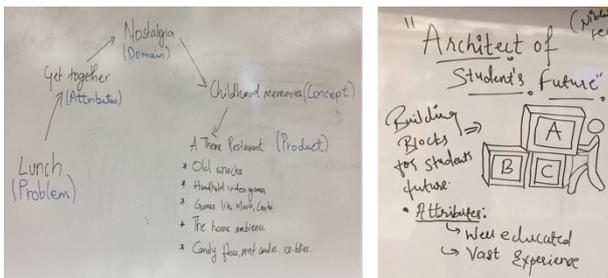


Figure 9. An example of two design concepts sketches generated by student groups.

One clear example of students working with the method was the following: A student group selected the design problem on how to find ways to teach sanitary to inhabitants in the slum (step 1: problem). After performing an initial research, the group decided that it was easier to get results if children would be the target group of a campaign, because it's harder to teach and learn new things for grown-ups. Students wanted to teach children cleanliness by digital channels like the

web and apps, things that children even in the slum often had access to (step 2: abstraction). The students presented a possible design concept to be used in the project. That was the concept of a *film* (step 3A: metaphors). In dialog with the students we asked to look at different levels of abstraction (step 3B: metaphors) of the design concept film. We asked if it was possible to be more concrete with questions like, “could it be a certain movie?”, “could it be a specific scene in a movie?” and “could it be a certain character in a film?”. In a couple of seconds, the students answered “Doraemon” as a possible design concept and solution to the design problem (step 4A: concept). Doraemon is a Japanese manga cartoon character well known in India. Let's stop for a while and look how well Doraemon fits as an equivalent in another domain for the design problem, teaching children in the slum sanitary. Here are some characteristics of Doraemon according to Wikipedia:

“Nobita is a young boy who suffers from poor grades, frequent bullying and negative emotions like sadness, jealousy, etc. In order to improve the life of his descendants, the robotic cat Doraemon is sent back in time by one of those descendants to protect and guide Nobita. Doraemon has a pocket from which he produces items known as "gadgets", which range from toys and medicines, to technology from the future.”

The students wanted to embodiment of the concept Doraemon and applied in media, such as webpages and apps (step 4B: concept). The design concept Doraemon can be easier to communicate within the group and to understand for stakeholders and the target audience. Last thing was to, in a concrete way, give answer to the implications of the concept. In other words: what metaphoric parts of Doraemon should be included in the concept and what parts should be excluded?

It was as if the students had the concept of Doraemon already in their head, they only needed to iterate and elaborate with different levels of abstraction (step 3-5) to get a concept less generic than the initial design concept *film*.

The time the students had at their disposal for making concepts varied between 30 minutes and 2 days and in the sessions in India we found not a single group of all the hundreds of students attending various business- and innovation programs that failed to make concepts during the three weeks period of teaching and workshops done by teachers from Mälardalens University with the proposed method. With not failing to make concepts we mean that all the students were able to separate between idea and artefact, they used metaphors as concepts and they were able to elaborate with different levels of abstraction.

TESTING OF THE CGM MODEL: PILOT 2

The students evaluation of CGM via open discussion and survey questionnaire gave important insights about CGM. Students felt that the main benefits of working with the CGM method are as follows:

- “Good for developing group dynamics”,
- “The method changed the focus”,
- “It opens up – we became more divergent”
- “It’s easy to get stuck in concept generation – the CGM gives you a broader view”

In addition, students also pointed out few challenges with CGM, including “difficult to begin– as always” and “to be on the same level with understanding and to find the rhythm.” Few students have also been working with other models earlier education in their, e.g. blending of concepts. However, they felt that CGM was a quite different approach compared to other models and was easy to understand and follow in generating new concepts. Overall, students gave a quite satisfactory average scores in a survey questionnaire, which falls in the category of agree mostly to agree completely (i.e. minimum score of 4.1 to maximum score of 5). All participants agreed that the new concept generation method is relevant for the design education and the method helped the team to find metaphors and concepts from other domains. One participant said that the method is “*a good and understandable way of working with the influence from other domains, generating new ways of seeing the actual design problem.*” In addition, participants felt that the new CGM not only made them more open minded and divergent but also made them to get a similar or shared view of the design problem. This is because the method facilitated students to achieve a common goal and understanding on problem, and helped to keep working towards realising the artefact. The outline of all questions, its average scores, and related comments is summarised in Table 1.

Question	Average score	Free text
The concept generation method is relevant for your design education	5	“More”
The method helped the team to find metaphors and concepts from other domains	5	“A good and understandable way of working with the influence from other domains – generating new ways of seeing the actual design problem”
The method helped the design team share a common vision	4.8	“Made us get a similar or shared view of the design problem”
The method helped your team in generating concepts in the design process	4.7	“Made us more open minded and more divergent”
The method can facilitate control of the realisation of artefacts	4.7	“Common goal and understanding in group helped to keep working towards something”
The method helped the team to sort out and keep relevant information particular purpose at hand by abstraction	4.7	“Stimulated new ways of looking at the problem and actually find the relevant information for the actual design problem”
The concept generation method can generate possible solutions in the future which cannot be forecasted at the present moment	4.5	“I could only see what I already knew and connect it to known things”
The method can facilitate the presentation of design	4.5	“Creates a roadmap (holistic) which is fun to explain”
The method dissolve, loosen up, fixations	4.2	“A different approach was a conclusion at the end”
The method helped the team to define implications for chosen concept(s)	4.1	“A bit short in time but the possibility was clear to see”

Table 1. An outline of survey questionnaire with its average scores and related comments

DISCUSSION

The paper proposed a new concept generation method, CGM, a method guiding students to generate concepts with multiple possible outcomes. To be able to do that we wanted to open the black box and give students some easy steps for how to separate between artefact and idea and give students a taxonomy for how to create and communicate concepts made out of metaphors, and further more learn students to iterate with different levels of abstraction in the whole process.

The method, CGM, do not contain or cover something that has not been covered before. The newness are the things combined into a method and to use tools, otherwise used to analyze, as tools to instruct in a design process. The rest of this section will be the final comments of the building blocks in the method, compared with other models/methods/theories.

Theory discussed abstraction as a prerequisite to use external sources to aid creativity (Goldschmidt 2011). To consider different levels of abstraction is, so to speak, a way to get a distance to the problematic situation and be able to see things from a broader perspective and avoid fixation (see figure 8 and “Abstraction” 2B). The next step in the method is to check if the properties from the abstraction fit any patterns in other domains (see figure 8 “Metaphor” 3A). In the current existing models, approaches, and methods, the concept generation process usually ends here (see for example Hey, et al., 2008). But in CGM, there are also instructions to look at optimal level of abstraction in the hypothesis for a possible metaphor. For example Cupchik (2003) discussed different levels of abstraction and finding the optimal level of abstraction in the construction of metaphors. Goldschmidt (2011) describes a similar process in what is called analogical reasoning. That is to shift between concrete to abstract and vice versa, which is a process of carry-over from source to target. “The higher the abstraction, the easier it is to avoid a simple replication of source properties in the target, and transfer relationships instead.” (Goldschmidt 2011 p. 97). This transfer is described by Dejong (1989) as shown in figure 10.

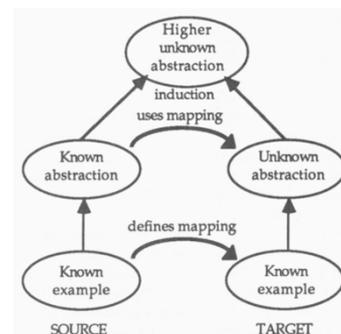


Figure 10: “Justified analogy” Dejong (1989)

We often encourage the students not to wait too long to create a first prototype (see figure 8: 4a). After that it is possible for the students to have iterations going back and forth all the way in CGM, and even check if they need to reformulate the problem. We believed that to have just one (1) artefact created out of an entire design process might be a little futile. The design concept might generate more artefacts both in the domain of the design problem and in other domains (see figure 8: 4B). As shown in the initial case in the paper, Louis Vuitton can make use of their concept “the art of travel” in both the domains of communication and in the domain of possible products to offer on the market. The students are often instructed to make use of their concepts in different ways and in different domains. As Schön (2013) claims in “Displacement of concepts”:

“It is sometimes useful and interesting to abstract concepts from the situations in which they are used. They have generality in the sense with tools have generality. They may be used in more than one situation. Abstracted from their situations of use, they can be looked at as forms of gestalts.” (p. 7)

Last but not least once the concept is formulated and different domains are explored, it is crucial to be explicit in how to use the concept. Because design concepts are to be used metaphorically and it is important to define what part of the source (in the metaphor) are going to be used in the solution to the design problem (see figure 4: 5). In other words, what kind of outcome do we want the concept to generate in different domains. The instructions of how to use the design concept are called implications (See for example Eppler 2006). That is to take away some of the ambiguity possible to show up in the interpretation of metaphors and concepts. The results of testing the CGM in two pilots showed that the new CGM is working and is an appreciated tool for generating concepts and that students thought the method was a relevant part of design education.

CONCLUSION AND LIMITATIONS

The paper made an attempt to open the black box in the concept generation and found that there is a need for a step-by-step generic method for concept generation with the following ingredients:

1. Treat the problem like a wicked problem
2. Make abstractions from the prerequisites in research and detach from the original domain by abstraction
3. Search for a metaphor in another domain. Iterate with the chosen metaphor by finding optimal level of abstraction
4. Then an abstract concept is created. Iterate with concept and try it in different top domains, like, products, communication and processes.

5. End station and solution is different artefacts based on the concept. Make sure to get the wanted interpretations of the concept by stating its implications.
6. Iterate. Again, and again!

The study has several limitations. In Pilot 2 the testing of the CGM was done with few informants. The workshop time was short, around three hours. There is also a possible bias in the validation since the teacher was both in charge of workshop and also the facilitator of the evaluation. In future, workshop is planned for a longer period of time and also to take more time to discuss the method with students in order to collect their perceptions and challenges. This initiative is already planned in the upcoming master program course called Project management in innovation and design, as well as in a number of undergraduate courses at Mälardalen University and other partner universities. We hope that CGM has the potential to be a part of generating concepts in more areas than teaching. That might be a possible next step to investigate.

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