



GENERATIVE RESEARCH IN DESIGN EDUCATION

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ABSTRACT:

This paper proposes a model of design research used to structure projects in design education, with relevant connections to design practice. Design projects are phased through *exploratory*, *generative*, and *evaluative* sequences of research and design. Generative methods are particularly unique. Participatory and creative co-design toolkits are distinguished by their potential use as projective techniques, allowing participants to project their thoughts, feelings and desires through ambiguous visual stimuli, and as constructive techniques, providing design elements for users to manipulate in guiding concept development. In addition to established techniques, innovative variations have been inspired by the philosophy of generative research. This paper will utilize examples from a university design program to illustrate a model of design research, with an emphasis on generative methods. The model will be critiqued as a structure for projects in design education and practice, including the challenges and opportunities of teaching research methods in a creative design context.

Key words: design education, research methods, generative research

INTRODUCTION

Human centered research should be an integrated component of the creative design process, rather than isolated from it. Furthermore, as an inherently creative activity, human centered design research should be flexible, allowing appropriateness to be the determining factor in selecting or inventing best methods for information collection, guiding inspiration, and the testing of ideas. This paper proposes a model of human centered research and design used to structure projects in design education, with relevant connections to design practice. The discussion will place particular emphasis on creative and participatory methods in design research, typically connected to the generative phase of the process.

The model utilized is situated in an academic design program, based in a university research institution, and has inspired students from industrial design, communication design, and interaction design, across physical and digital dimensions. The model is provided as an explicit structure within several courses and studios, including an elective project class in human factors research and design, and a graduate studio project linked with a research methods course requirement. Additionally, as part of the research culture within the school, the model occurs as an implicit sequence of research and design activities in several other projects and studio courses.

FORMER MODELS

Formerly, the structure of design research projects was typically distinguished by only two general phases, likely familiar to many schools and practice. In this model, an initial phase of pre design and early concept development research is variously referred to as formative, discovery, exploratory, or generative. Activities in this realm involve all methods of collection to inform design opportunities and concept development. There may be creative and participatory elements during this first phase of design research, corresponding to a model of generative research proposed by Sanders et. al. (Sleeswijk Visser, Stappers, van der Lugt, & Sanders, 2005). Once concepts are defined enough to gauge feedback, the latter phase of design research consists of iterative testing, or evaluation research.

Historically, much of human research in design has been conducted as testing, or as an evaluative function to assess the outcomes of design and engineering against user performance. Upon developing a prototype or product, it makes sense to solicit feedback on usefulness and usability. Evaluative research is well documented,

for example, in human factors literature on product testing (for example, see Charlton & O'Brien, 2002).¹ Subsequently, the value of user studies has gradually become recognized, targeting the collection of information about people and products at the front end of design to inform creative decisions (Hackos & Redish, 1998). While clearly preceded by marketing studies that focus on demographic profiles and consumer purchasing behaviors, user research in design places greater emphasis on holistic behavior patterns and contextual inquiry. More recently, generative research has gained in recognition and popularity, built on the strengths of the participatory design movement (Sanders, 2000).

NEW MODEL

In the two-phase model described above, the level of appropriate specificity expected as they approached concept definition often confused students. Questions arose as to when early phase research should be targeted toward a basic understanding of the territory under design investigation, versus the uncovering of ambiguous user needs and wishes, and when it was appropriate to move toward specific manifestations of user expressions in product form. This confusion was particularly acute when deciding on participatory design research methods, or other forms of research involving direct contact with participants.

The new model therefore proposes three main stages of research within the design process, phased through *exploratory*, *generative*, and *evaluative* methods of research and design (Figure 1). User and product studies, intended to forge a knowledge base and empathy with people and things, particularly in cases where students may be engaged in unfamiliar territory, characterize exploratory research. Generative research is a more focused effort targeted at a deeper understanding of user needs and desires, and concept development through participatory design activities. Evaluative research combines more established methods to test emerging design concepts against user expectations. The sequence of research by no means dictates that particular methods are isolated for use within specific phases, but rather may be used flexibly across the stages of research and design. Furthermore, as indicated by the diagram, the phases of research tend to overlap both in timing and methods, rather than existing with distinct start and end points.

¹ It is interesting to note that even here in a text on testing and evaluation it is acknowledged that research formerly relegated to the end stages of design and engineering is now becoming a more thoroughly integrated component of the entire product development process. In addition, the authors include discussion of "generative search" in product development, in a chapter by Gage, Sanders & Williams.

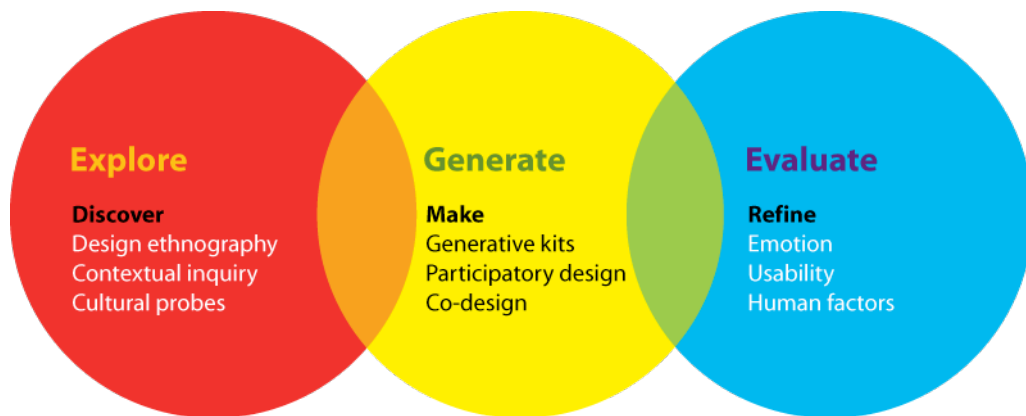


Figure 1: Model of design research

Within exploratory research, students will conduct surveys and questionnaires, observe and talk to people, shop for and try products. Methods are typically ethnographic in nature, and may include participant observation, artifact analysis, photo and diary studies, contextual inquiry, cultural probes, and other methods designed to sample human experience. Exploratory research culminates in a comprehensive understanding of the people and the territory under investigation, and ideally results in implications for design.

Generative research opportunities are set by the exploratory phase, and may include similar methods. Certainly a continued emphasis on empathy for users is encouraged, and any means to this end are supported. Diaries, with or without a photographic or imaging component, may be favored and are often issued as an advance probe or instrument to sensitize participants to the topic area and prepare them for participatory exercises. Participatory methods will include toolkits such as card sorting with images or text, collages, cognitive mapping or other diagramming exercises, experience drawing, and flexible modeling, or Velcro modeling. Participatory design methods may also include co-design activities, a collaborative design process between user and designer (Sanders, 2000).

Generative research is further distinguished between projective and constructive methods (Figure 2). Early exercises are typically projective in nature, focusing on expressive exercises enabling participants to articulate thoughts, feelings, and desires that are difficult to communicate through more conventional verbal means. Furthermore, the creation of an artifact around which a participant may talk will act as a trigger for engaged and comfortable conversation. Projective methods are typically ambiguously instructed, and will include the creative range of collage, drawing, diagramming, image and text based exercises. Constructive methods such as flexible modeling will occur as a later means of concept development, once some concrete parameters are set for product ideation. The key in developing a kit of parts for exercises such as Velcro modeling is to have

enough concept variables defined to constrain the field for participants and avoid overwhelming them, without limiting the candid insights that come from flexible, creative play.

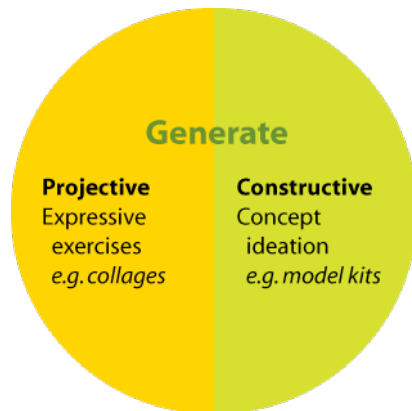


Figure 2: Model of generative research

Evaluative research, as one might expect, attempts to gauge human expectations against the designed artifact in question, determining whether something is useful, usable, and desirable.² The methodology may be tightly controlled corresponding to an experimental model of lab testing, or may involve flexible evaluations by people using products or prototypes in context, or some combination thereof. While it is tempting to differentiate evaluation research as having less creative opportunity than exploratory or generative research, the following examples will suggest otherwise.

The remainder of this paper will provide examples and a discussion of creative methods in the new model of design research, particularly as they are used in the generative phase. Creative methods have been previously distinguished as *innovative* methods developed specifically for design, contrasted to traditional methods used similarly by many disciplines, and adapted methods, borrowed from other disciplines and altered to meet the needs of design (Hanington, 2003).

SAMPLE PROJECTS

The following project examples have been collected from various courses and studios, at both the undergraduate and graduate level. Creative methods are typically associated with the generative phase of design research. However, in all cases, significant exploratory research was completed in addition to the

² The phrase “useful, usable, desirable” was first coined by Elizabeth B.-N. Sanders (1992), and has since been in popular usage throughout design research.

generative methods, and in cases where testing is not an explicit component of the activities, some form of evaluation research was also conducted.

In the first example, a student working with the Boys and Girls Club was interested in designing improved environments or products for creative play in an after school program. Exploratory research was easily facilitated through her existing employment with the Club, providing ready access to administrators, teachers, and children in the program, for conversations, interviews, and surveys, in addition to observations and documentation of activities in the current environment. Of course, there was a caution of bias due to familiarity with the context of study. Generative research helped to overcome some of this potential bias, as exercises were created to elicit open-ended, projective information.

Children were asked to complete three activities. First, they were asked to create a self-portrait incorporating images that represented things they like to do (Figure 3). Second, the children organized a variety of images that represented arts and crafts materials and activities. Third, they were asked to select favorite color swatches and place them together. Collectively, the exploratory and generative research provided rich insight for moving the project forward (Figure 4). The design outcome was a creative activity box that was then tested through interactive play and feedback from the children, to fulfill evaluative research requirements.



Figure 3: Generative exercise: Self-portrait (from Jennie Keinard, 2006)

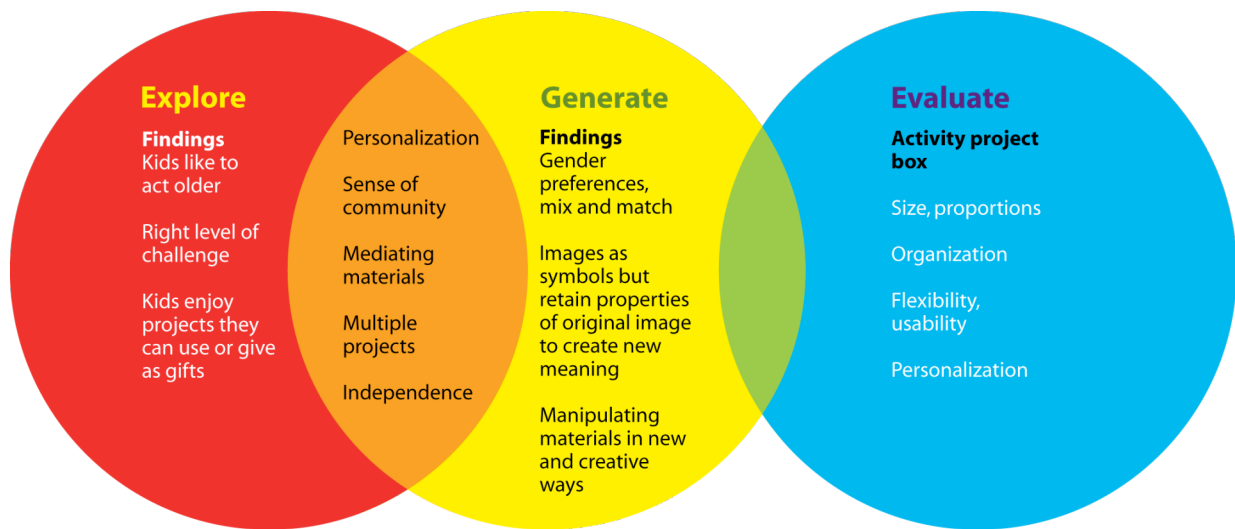


Figure 4: Summary findings from sample research project (adapted from Jennie Keinard, 2006)

In graduate studios connected with a research methods course, students typically work in teams on a client-based project. A recent project had four teams dealing with new technology and mobile media. During the exploratory research phase, students examined many current and emerging products, conducted “touchstone tours” whereby participants guided researchers through their array of mobile devices, and utilized surveys, interviews, and observations of people, documenting inventories of existing and favored products, to understand the user group under study. Some teams also issued self-report diaries to gain further insight into behavior patterns with respect to use of mobile devices. Other teams reserved diary studies for the generative research phase, where they combined the method with exercises such as collages, or diagrams allowing participants to describe personal relationships and communication patterns. In this case, because the product environment was pre-established as mobile devices, most generative exercises were in the projective realm. Once concepts were developed, evaluation research followed more traditional means of interface testing and feedback.

Exercises may also exist within faculty research projects, with student involvement. In a client-based project on appliance design, combined teams of faculty members and students first engaged in ethnographic studies to understand the landscape of issues related to human aging and design. Frequently working in pairs, the researchers interviewed and videotaped participants in their homes, documenting their conversations, behaviors, appliance products, and interactions. In combination with more traditional methods such as literature reviews, these methods of exploratory research helped to highlight primary issues, forging a sense of

empathy among the designers, and laying the groundwork for generative research. For one of several generative activities, a small team of graduate students worked with a faculty advisor to develop a portable research kit targeting functional preferences for microwaves and stove tops. The constructive kit contained card and paper templates with various appliance functions, displays and controls (Figure 5). Participants were asked to select preferred features, arrange them, and then simulate assigned cooking tasks. The exercise was informative in identifying preferred functions and sequences of common actions, setting some parameters for concept development. Eventually, exploratory and generative research would lead to appliance design prototypes, evaluated through interactive testing sessions in a mock kitchen.



Figure 5: Generative constructive kit for appliance design

PROJECTIVE FOCUS

Within generative research, projective techniques are particularly effective for students engaging in ambiguous topics with undefined outcomes. In one example, a student exploring the broad territory of design and emotion looked for ways to define product form and kinetic operations for various emotional responses. An innovative projective exercise instructed participants to model emotions with flexible clay, under a table, without looking, to extract a map of common features for negative and positive emotions (Figure 6). The evidence was compelling. Negative emotions such as “confusion” invariably contained more multi-pronged forms, with sharp, narrow protrusions. Positive emotions contained smooth, spherical forms, sometimes resulting in representative shapes such as hearts.



Figure 6: Projective techniques: Modeling emotions
(Sonia Wendorff, 2003)

In a subsequent phase of the project with a more constructive focus, the student developed small disc-like forms with various kinetic operations to open and close, such as sliding, pivoting, and folding. To extract feedback on these concepts, the student had participants engage with the objects, then sort them with a choice of images and words to express positive or negative reactions. The relative emphasis on projective techniques within generative research for this project is indicated in Figure 7.

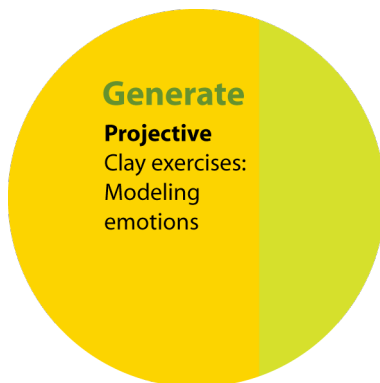


Figure 7: Projective focus in generative research

CONSTRUCTIVE FOCUS

In many projects, students have a fairly concrete design topic established from the beginning. In such cases, generative methods tend toward the constructive, rather than projective. For example, a student investigating children's interactions with drinking fountains developed an exercise where children drew or configured basic outline drawings of fountains, and then colored them, to express aspects of their ideal fountain. In a second

exercise, they configured three-dimensional forms to indicate their favored water spouts, and then interacted with various prototypes for triggering the water flow, such as pushing buttons and bars, turning dials, or stepping on foot pedals. The outcomes of these various exercises were combined to establish a prototype for testing with children, and finally a design concept for a communal drinking fountain (Figure 8).



Figure 8: Constructive methods and concept development (Pam Hansiripongsakul, 2003)

In another example, a student working with outdoor enthusiasts attempted a collage exercise, where participants were instructed to sort camping contents into a line drawing representing a backpack form. When this proved inadequate for providing good design information, the student developed an impressive full-size Velcro modeling kit, complete with backpack frame and components. With participants now able to construct an actual backpack, stuff it with supplies, and try it out while communicating their preferences, the student gained inspiring feedback for moving his design concept forward to completion. Here again, the generative methods used were in the constructive range. In this case, the modeling method also served an evaluative purpose, testing a set of concept components defined by the student. The focus on constructive methods of generative research in these two projects is illustrated in Figure 9.

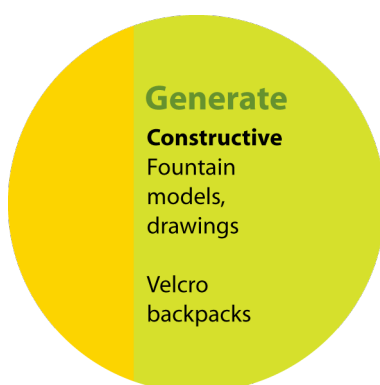


Figure 9: Constructive focus in generative research

COMBINED FOCUS

Sometimes the territory of a project is set, but concept outcomes are undefined. This presents opportunities for both projective and constructive exercises. In an integrated product development course, student teams working with truck drivers to improve the experience of long haul living investigated design opportunities for the truck as both home and office space. Projective exercises consisted of image, word, and icon placements on magnetic panels. Utilizing both metaphorical and representational elements, the attempt was to gain some understanding of what “My Truck”, “My Work”, and “My Home” meant to truckers (Figure 10).

The student faced many challenges in recruiting participants in truck stops for these abstract creative exercises, having more success with the concrete nature of constructive activities. Constructive exercises included image placement and annotations to suggest interior layouts on a simple line drawing of a truck cab, leading directly to concepts presented for evaluation research in CAD and foam-core models. Ultimately both methods proved to be insightful, and useful in facilitating conversation between two disparate groups, students and truck drivers. The creative means of generative research were mutually beneficial in establishing a connection between design researchers and participants, valuable for both the collection of information, and in forging an empathic understanding of users unfamiliar to the student designers. This balance of projective and constructive techniques is illustrated in Figure 11.



Figure 10: Generative research collage with truck drivers
(Catherine Sun, 2006)

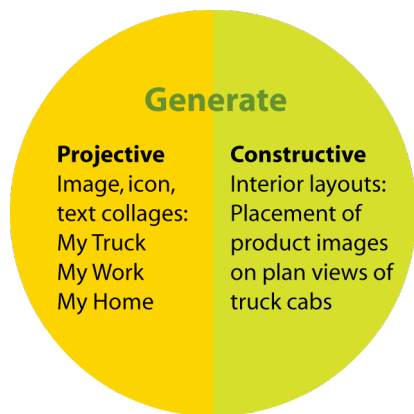


Figure 11: Projective and Constructive focus

EXTENDED LESSONS

A critical lesson implied by the instruction of generative research methods and by examples provided to students, is that the techniques themselves are inherently flexible, and limited only by the creativity of the design researcher. It is rewarding to see how new methods are adapted and made to fit particular situations, most often with valuable insights gained. For example, students wrestling with how to collect potentially self-conscious information during an investigation of public bathrooms developed a method of “graffiti walls”, whereby bathroom walls were papered and left with markers for candid feedback on the experience of bathroom use, and to provide suggestions. In another phase of the project, a flexible scale model of a bathroom and fixtures was created, and participants were invited to role-play various scenarios set up by the design researcher, using the model and action-figure dolls (Figure 12).



Figure 12: Role-playing scale model
(Purin Phanichphant, 2005)

There are many examples of innovative adaptations to standard toolkits for generative research. Scale models with ambiguous environmental features have been used to gain insights from participants as they configure parks, dentist offices, and worship spaces. The basis of Velcro modeling has been translated to graphic and interface design, as participants have been asked to select and arrange paper or digital elements to indicate their preferred features and layout for print posters, websites, or screen-based devices. A collage kit has been adapted for perpetual use and re-use by laminating image and text cards, and having participants conduct multiple exercises on fabric-covered surfaces. And in a project concerning cosmetic bottles that would be difficult to physically model, participants expressed their preferences using a creative kit of transparent texture swatches and colored underlay sheets.

EDUCATION AND INSPIRATION

The teaching of creative research requires a different tactic than the instruction of other methods. Traditional methods such as surveys and questionnaires, interviewing, and various forms of observation typically have prescribed protocols attached to their design and conduct, with standard examples available to use as guiding templates. While it is certainly possible to replicate many forms of generative research according to precedents, the real goal in teaching the methods, and even in providing samples, is to inspire the development of new and innovative methods, created to suit the unique characteristics and questions of the particular design situation at hand. Fortunately, when contextualized in design, the teaching of generative research represents an excellent fit with the mission and methods of creative education.

There are limitless possibilities for methods in generative research. The philosophy of generative research, one that promotes creative and participatory exercises to enhance the collection of information to guide inspiration, is a natural fit for the innovative process of design. In similar fashion to the act of designing itself, designers can adapt methods to the situation, play and explore, and take chances and learn, through success and by mistake. Generative research tools present an ideal opportunity to immerse students in a process that integrates research and design activities, being at once creative with the methods employed to collect information, and in realizing the potential of applications from insights gained.

The challenges of quantitative and qualitative analysis are highlighted in generative research, and the balance must be weighed, as appropriate for each situation. The insights gained from participatory design are critical to broadening the perspective of the young designer and illuminating how potential users may provide guiding information, contextualized within the process of creative decision-making. However, through synthesis and analysis, the designer must still take responsibility for filtering and executing ideas. For example, if research

participants in flexible modeling exercises consistently select a particular feature and locate it on a form in a common configuration, the designer must exercise his or her creative authority to translate this information into design criteria, and ultimately into specified interactions communicated through design language. In this way, generative research is used to guide inspiration, an activity different from traditional data collection, analysis and application.

This is not to say that there is not rigor in the possible means of analyzing creative information provided through generative research. As suggested by Robson (2002), it is well advised even in qualitative research to maintain a scientific attitude, to conduct research “systematically, skeptically, and ethically” (p. 18). Various forms of content analysis are an appropriate means of analysis, looking for clusters, patterns, and themes in the information provided by participants. This may involve playing with the information in several ways, by individual designers and collectively in teams. At one extreme, simple counts may be used to indicate how many times a word or image has been used in a collage or diagram, or mathematical schemes including multi-dimensional scaling may be utilized to decipher patterns and connections. More typically, affinity diagramming, or the clustering of common items until categories can be built and named, will be utilized to identify key themes. Particularly because generative research will involve smaller sample sizes than scientific research, much of the analysis can be done manually.

Exercises in creative research provide an excellent vehicle for highlighting methodological issues for discussion. Students raise valid concerns on the potential bias introduced by the pre-selection of toolkit parts, whether for collage, card sorting, or concept modeling. There is frequent learning on the appropriate conduct of sessions, from the preparation of toolkit parts, to the flexibility necessary for unexpected participant interpretations and expressions, to being convinced that all people are capable and willing to be creative. The trepidation expressed by students when embarking on generative research is typically followed by exhilaration at the results that emerge from dynamic and inspiring research sessions, and the willingness of participants to engage in a research process more enticing than traditional surveys or interviews. The experience serves well to replace negative stereotypes of conducting research with the exciting potential of new methods, helping students realize the value of insights gained through a participatory, creative process.

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