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EXTENDING PRODUCT AFFORDANCES TO USER MANUALS

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ABSTRACT
The aim of this study is to provide general guidelines on methods for designing user manuals. The goal is to illustrate the dependencies between product affordances, semantics, and user instruction. The study incorporates task-based reflective interviews with product design professionals who were charged with redesigning a manual for a product. The article emphasizes the application of a pedagogical instructional design (PID) approach to user manuals in which users aim to construct the meanings of a product and incorporate these into living practices.

Keywords: user manuals, instructional design, affordance

1 INTRODUCTION –PRODUCT AFFORDANCES VERSUS PRODUCT FEATURES

As shown by research, only a small percentage of all technically well-designed products is successful in the marketplace [1]. Although a product may be technically advanced according to its functional features and even usability, it may still not be picked up by the market. For a product to be successful it must be acceptable to users on a range of levels, which are not necessarily technical or usability related. Users embark on a journey of understanding the product's physical-functional advantages, accepting them and learning to like them. They must also appreciate the metaphysical advantages of the product. In his discussion about product semantics and design, philosopher Klaus Krippendorf [2] was explaining how products are not merely the sums of their features and functions but rather a series of interfaces that enable users to develop meaningful practices around activities and tasks. Furthermore, he claims that design has an important role in enabling users to "make sense of things." By things, Krippendorf means the interaction between users and products that takes place over time as the user adopts a product in his/her own "living practice." Accordingly, a product has properties that intervene in user practices and enable interaction and adoption. A user gives meaning to objects and products and can anticipate and undertake interactions with them to attain living practice. The constructed meaning by the user gives semantic properties to a product, and user anticipation of interactions confers affordance properties on the product. These concepts (semantics and affordances) of the properties of a product have long occupied product design researchers and practitioners and are used in many contexts [3]. According to the user-interface researcher Norman [3], when designers take affordances into account, users can intuitively perceive the use of a product, without the need for instructions or explanatory markers. Therefore, creating appropriate perceived affordances through considerate design decisions is a major key to usability. From this perspective, if a product needs instructions to enable an interaction with a user, its design is flawed. Although designers can strive to achieve affordances and semantics in design, they are not easily achievable, as these properties are realized through individual interactions over time. It is important to state that Krippendorf does not view usability as the most important characteristic of a product but considers it the most meaningful one in the interaction between the user and a product.

The premise of the present study is that although the ideas such as affordance and product semantics are integrated in current design processes, user manuals often do not take these elements into account. Instead, they focus on safety issues and the accuracy of descriptions of product features. The latter may be explained by the lack of involvement of designers who are specialists in user experience in the design of user manuals. Additionally, although product semantics and affordances have been much studied in the context of product design and development [3], there seems to be little research on how product affordances and semantics translate into user manuals and packaging. This topic is of interest because both packaging and manuals have an impact on the acquisition, discovery, and first use of a product. In that sense, product semantics is important in packaging as users try to evaluate the meaning of a product. At the same time, product affordance is important for user manual design as users try to determine the possible uses of a product.

The present study mainly focuses on user manuals and the integration of the product into users' living practice. The following research question is addressed: How can product affordances be extended to manuals? This question is addressed in the context of design workshops and methods for designing manuals and packaging. The study focuses on user instruction, user practice around the product, and the construction of meaningful interactions between the product and user.

2 METHOD - PEDAGOGICAL INSTRUCTIONAL DESIGN (PID)

User instructions or user manuals are instructional booklets designed with the goal of providing an overview of a product and essential information for the user to operate the product. According to a previous study [4], users tend to avoid both paper manuals and electronic issues. The study found that users have difficulty connecting the instructions with the practice of using the products. Conventionally, user manuals are included with products in packaging and contain detailed information about the features and benefits of the product. As increasing numbers of products are being digitally integrated, and paper manuals (and updates) are becoming obsolete, they are being rapidly replaced by other media, such as video and software wizard guides. However, paper manuals remain used in the most first-use situations.

The aim of this study is to provide an alternative way of designing manuals, where user-intended learning outcomes of manuals are matched with appropriate learning processes or methods. Therefore, a pedagogical approach to the design of instruction manuals is adopted. PID is the practice of creating "instructional experiences that make the acquisition of knowledge and skills more efficient, effective, and appealing." [5]. PID theory has been applied mainly in schools in context of course planning. However, its application to manuals can illustrate from a pedagogical perspective how design can help users connect instructions to their living practice.

The research design is based on the assumption that designers trained in creating product affordances and semantics will be able to find ways to emphasize these properties in the redesign of a user manual. The focus of the study is on the strategies that they adapt from the perspective of PID. The analyses of the data are presented using an illustrative case study [6]. The intent of the case study is to illustrate various aspects of design work that are encountered when designing manuals. The data were collected through reflective, task-based interviews [7] and participant observations [8]. The reflective interviews have a similar task-driven flow as design workshops. This method was chosen to allow us to study the personal attitudes of individual design professionals and their coping design strategies in the redesign of a manual for an existing product. It also allowed us to collect data that are difficult to obtain in a workshop situation when design concepts emerge through participatory processes.

Interviews were conducted with three product design professionals who were given the task of redesigning a manual for a dremel hand piece with add on tools for which the designer could also be a user. This product (Figure 1) has a simple function but switchable components, enabling the designer to utilize it for different usage scenarios. Therefore, the perceived affordance is highly dependent on previous knowledge about usage and testing of the tool. This product was chosen as exemplary for a product designer in order to study how perceived affordances can be translated into a manual. Product design professionals are sufficiently skilled to develop a concept sketch of a manual in the short period that a reflective interview allows. There is very little images and information in the manual provided with the Dremel tool (Figure 1), which is expected to create a certain degree of confusion among the participants.

The interviews lasted approximately 20 min and took place in two phases. In the first phase, the design professionals were given the task of opening the package and putting the product to use, as they would

do had they purchased the product themselves. They were not directly instructed to use the manual. However, they were asked to comment on their actions and express their opinions on how the product performed, in addition to their experience of assembling the product for use. Once the product was assembled, the participants were asked to comment on how they could use the product in their own design work, as well as how it could be used in general for different user groups, especially hobbyists for whom the product was intended.

In the second phase, the design professionals were instructed to redesign the manual for the dremel hand piece and add on tools. They were encouraged to comment on the user manual and its effect on the preparation for use of the product. They were also asked to judge the effect of the manuals on the product usage.

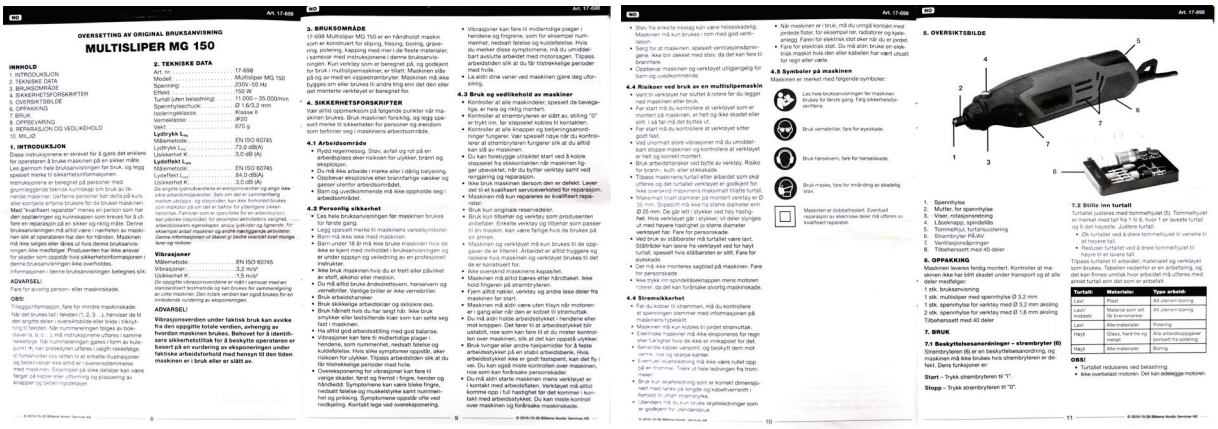


Figure 1. User manual for the dremel hand piece with add-on tools

3 CASE STUDY - CONCEPTUALIZING USER MANUALS

All three design professionals first tried assembling the add on tools to the dremel hand piece without opening the manual. All three experienced difficulties determining how to exchange add-on tools, particularly how to tighten the bolt that holds the add-on tools in place. After a number of failed attempts, they turned to the manual, which did not seem to be of help. They finally discovered that the top button should secure the motor axel when tightening the bolt (Figure 1, bolt 2, button 4). This discovery came only after examining the features of the product one by one. This event caused a lot of frustration among the design professionals and colored their add on tool mounting experience and further discussion. All the participants noticed that usage descriptions of the add-on tools were not included in the manual. When questioned about the uses of the different tools, the participants drew on their previous experiences. The third participant responded: “This circular plate is for cutting, and it is similar to one I have on my drill.”

3.1 Interview 1 - You-tube manuals

The first participant already owned a different type of the dremel hand piece, which featured a different system for tightening add on tools. This participant tried to draw on previous knowledge to accomplish the task. The participant had also used the Dremel in personal projects and therefore had clear and defined ideas about the add-on tools and their usage. “I use it to polish fired ceramics before I glaze them. I have found no other uses for it.” When asked to recall the first time she had tried to set up the product, the participant said that she had not used the instruction manual and had tried to find the required information on the internet, finally searching for the instructional videos. She explained: “I tried to find some useful videos, but the presenters took as long a time to get to the point, as did the manual.” Based on the participant’s experience, she arrived at the following insight as regards concept development in manual design. The participant stated: “I actually would not mix safety and usage instructions in the same manual. I would put the safety instructions in a paper manual and product usage on a video.” For example, the need to hold the button to fixate the motor axis while tightening the bolt could be best explained by a medium, such as a video, that includes time as a dimension. The concept proposed by the participant included providing a QR code on the packaging and a three-letter link to a webpage, where the user could watch instructional videos. The participant emphasized that the instructional videos should feature experts and contain footage of the most important aspects of the

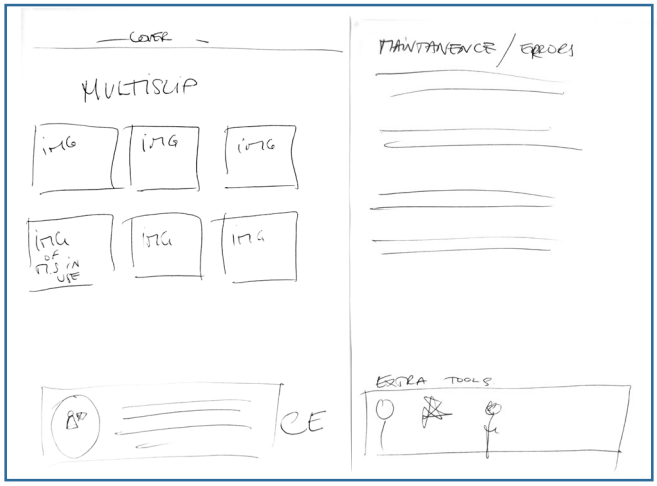
product usage. The videos should depict different experts successfully using the Dremel and contain stories on how this tool helped them accomplish their design or model-building tasks. She stated that this should be done for every tool in the product series, with a series of videos of the use of different tools in different stages of design or model-building projects.

3.2 Interview 2 - redesign of the paper manual

The second participant had a more critical outlook on the product. She stated: "The manual aside, the product itself seems to be useless and therefore badly designed." She further explained that she was very selective about the tools she allowed in her workshop and that given the amount of space taken up by the tool, a drill or performing the task manually would be better. When asked to propose a better user manual design for the product, she said the product probably had a very narrow user group and proposed more research on "core users" of this product. Her concept for the paper manual included so-called action images (i.e., images of the product in use) on the cover of the manual and packaging of the product. Her reasoning for these images was as follows: "For a narrow user group, such as figurine hobbyists, it is important to show the product in action to enable potential users to imagine how they could get the most from it (Figure 2). The participant also stated that the manual should conclude with information on other possible add-on tools to provide inspiration, in addition to other products that could be used to finish off the design work. In addition, she strongly advised that the first page of the manual should contain a step-by-step set up, with images.

3.3 Interview 3 – user manual integrated into packaging

The third participant took the most time to figure out how to mount the add-on tools on the Dremel. She was mostly concerned by the operation of the product features. She stated: "This manual is useless, as expected. It is difficult to understand what do manuals include and where does one language section stop." She said that user manuals always tend to provide the wrong information at the wrong time. In relation to how to connect the information given to the product itself and provide this information in the right place, the participant proposed abandoning the manual completely. Instead, she proposed including markings on the packaging that would guide the user through the setup and usage. She proposed a plastic suitcase package (Figure 3), which contained the add-on tools in the top part and the dremel hand piece in the lower part. The top part should include sticker of the matrix schemes of the images representing different materials and surfaces that could be accomplished by using the different add-on tools. In this way, the user would have a permanent overview and inspiration as to what could be achieved with the tool. The lower part would also include stickers with pictograms (fingers and arrows) showing where the Dremel and accessories were to be placed.



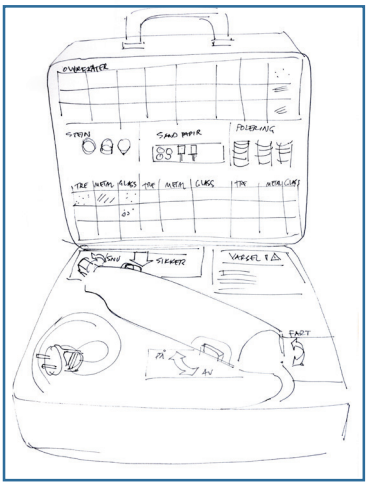


Figure 2. Interview 3, paper manuals Figure 3. Interview 4, manual integrated into packaging

4 FINDINGS – MATCHING INSTRUCTIONS AND LEARNING OUTCOMES

Although all three participants experienced the same problem when switching tools, the solutions they proposed seemed to be constructed from personal experience and personal interpretation of the problem and preferences for the solution. The designers used different media for their user manual concepts, but the content focus was relatively similar, with two distinct topics emerging. First, as expected, the designers tried to design better set-up or operative instructions to quickly enable users to start using the tool. Second, they focused on the context of the product usage and the implications of such usage for user instructions over time in different settings. They developed different approaches to designing instructions for these two different goals (Table 1). These approaches can be analyzed using PID, which involves matching learning outcomes with learning methods or instructions within situational and contextual constraints, understanding potential sources for solutions (e.g., theories of human learning), and integration of the selected strategy [9]. To accomplish this matching, the instructional designer needs to predict and design a plan for the learning experience. In developing this plan, the learner's perspective should be considered, and an appropriate viewpoint on learning or a suitable learning theory should then be selected. Accordingly, the three main perspectives of PID are behavioral, cognitivist, and constructivist [9].

Table 1. The emerging concepts for the manual

Interviews/ instructions	Interview 1	Interview 2	Interview 3
Operative	Demonstration and modeling	A step-by-step pictogram guide	Instructional cues
Inspirational	Exemplification	Action images	Material-surface schemes

4.1 Behavioral approach

The behavioral approach to PID assumes that learning is accomplished in the presence of an appropriate response to a specific environmental stimulus. In this approach, instruction is structured around the presentation of a target stimulus and the provision of opportunities for the learner to practice the proper response. "To facilitate the linking of stimulus–response pairs, instruction frequently uses cues (to initially prompt the delivery of the response) and reinforcement (to strengthen correct responding in the presence of the target stimulus)" [9]. The behavioral strategy includes informative feedback, tangible rewards, the use of cues, practice to ensure a strong stimulus–response association, and the use of prompts. The second participant proposed the use of a step-by-step pictogram guide, which focused on reinforcement of a repetitive task (skill in exchanging add-on tools) as an aid to learning. This approach uses informative feedback in which a user can gain a tangible reward on the performed task. The third participant adopted a similar approach, connecting the stimulus directly to the environment by attaching a cue in form of a sticker to the dremel hand piece bed.

4.2 Cognitive approach

The cognitive approach to PID focuses on conceptualization of learning processes and how information is received, organized, stored, and retrieved [10]. Learning is defined entirely not by what learners do but by what they know and how they come to acquire this knowledge. Learning results when information is stored in memory in an organized, meaningful manner [10]. Prior knowledge is used to establish a frame for identifying parallels with freshly acquired information. The cognitive approach employs analogies and metaphors, framing, outlining, mnemonics, and concept mapping [11]. The third participant developed a concept of creating materials-surfaces schemes linked to the set of add-on tools that gave the user an overview of the functions of the different tools. This strategy relies on a cognitive instructional approach to enable the user to draw analogies between the add-on tools and surface qualities of the treated material. This approach enables the establishment of organized and meaningful knowledge over time, enabling the user to make informed choices in everyday practice.

4.3 Constructivist approach

Constructivism theory views learning as creating meaning from one's own experience. As there are many possible meanings that can be harvested from any experience, there is no one predetermined, right meaning. Constructivism focuses on learner and environmental factors and the interaction between these factors in the creation of knowledge. Knowledge is accumulated through interpretation and reinterpretation of previous interactions and practice, enabling the learner to learn specific concepts over time [12]. The goal of instruction is to accurately portray tasks, not to define the arrangement of learning necessary to realize a task. The constructivist strategy focuses on creating a situational context to allow users to define the problem, often in real-world contexts. It utilizes cognitive approaches, such as modeling and coaching, in addition to multiple perspectives and participatory contexts, such as debating. The first participant relied almost entirely on this instructional approach in her proposals for both set-up, operation, and various uses of the dremel tool. She proposed introducing the user to real-world uses of the tool, including the use of expert testimony, coaching, and demonstrations through modeling and apprenticeship. The second participant relied on a constructivist approach to instruction through "action images." The action images of the product did not depict how to use the product but rather encouraged personal interpretations of the possibilities of potential uses.

5 FROM USER INSTRUCTION TOWARDS USER INSPIRATION

In this study, the participants, who were placed in the roles of users and designers, extended the focus of the original manual and introduced different dimensions of product usage in different contexts. They addressed product affordances in a step-by-step guide in which the improvisation space was minimal. In addition they focused on applications of the product in different usage situations in which the manuals have more of the inspirational role. Based on the findings of this study, participants tried to express product affordances in the user manuals.

Implications for the user manuals design are that if the information about the operation of the tools is the focus of a manual, the behavioral approaches to instruction can be recommended. On the other hand, when the learning is more meaningful and the focus is on product affordances, a constructivist approach to instruction is warranted. Finally, user manuals should perhaps not be assessed based on how accurate, useful, or effective they are but rather on how inspiring they are for learning. According to Krippendorf, the adoption of products relies on users constructing meaning through interactions with the product in their own living practice [2].

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