Repertory Grid Technique - a window to professional thinking?

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Abstract
In the planning, development and evaluation of education in technology and design, relevant information gathered from professionals in the field plays a crucial role. It is therefore important to turn to those who are actively engaged in a profession that involves engineering or design. We present an ongoing research project that is aimed at the use of the Repertory Grid Technique to examine and compare expertise among engineers and industrial designers, in order to find information useful to the development of technology education. The key concepts of Repertory Grid as a research tool used in interview design and its advantages and disadvantages are discussed. A pilot study has been conducted using this technique and preliminary results and analysis is provided.

Introduction
Higher technology education in Sweden has its roots in the development of the military industry (Sundin, 1991) and technology as a subject in school derives from slojd. In the late nineteenth century the school subject slojd would give pupils practical skills for work at home, in the industry or with craft activities (Hagberg & Hultén, 2005; Lindström 2003b). The curriculum of 1962 describes technology as applied natural science. In the early eighties technology became a compulsory school subject but received a syllabus, first in 1994.

Technology and design are discussed today within the same educational context. Earlier the term technological education brought to mind words such as constructions mechanics, inventions and education in engineering. Design education has been linked to education in the fine arts, handicraft and formgivning. The Swedish word formgivning describes the process when a creator gives form to an object or an environment1. In everyday speech in Sweden the word design refers to the shape or the appearance of a product2.

Richard Kimbell’s definition of design is that it is a way of thinking and that it can be used in many different educational situations and professional practices (Kimbell & Stables, 2007). Kimbell is describing designing as an interaction of the mind and the hand, a combination of reflection and practice (Ibid. p. 16). Central to the interaction of the mind and the hand model is the need to visualize thinking. This can be done in different ways; the first step can be sketches, discussions or notes. The visualization becomes progressively more specific, in the end a model or prototype. The model can be expressed in different ways, visually, in writing, orally, numerically or materially (Ibid. p. 221). Kimbell links together the concepts of technology and design. Design is the process where the invention and creation takes place, technology is the tool for realisation (Kimbell, lecture, 8 May 2009, Stockholm University, Sweden).

1 2009-06-26 Nationalencyklopedin • Lång
http://www04.sub.su.se:2291/lang/formgivning
2 2009-06-26 Nationalencyklopedin • Lång
http://www04.sub.su.se:2291/lang/design/152567
Looking at the marketing\(^3\) of high-tech advanced products, it is noticeable that form, features and the ability to communicate are prominent qualities. When form, function and usability merge into a complex artefact it may be difficult to distinguish designing from engineering. In recent years in Sweden the concept of design has also started to be used as a description of a process similar to Kimbell’s definition of the concept. A good illustration of this is the government's call for *The Design Year of 2005*\(^4\) and the publication of the popular science book *Designmedvetenskap*. *Designmedvetenskap* was published by the Swedish Research Council (2004) just before the start of *The Design Year of 2005* and is an example of a publication characterized by this new broad picture of design and design research.

The extended use of the concept design is reflected in the range of higher education in Sweden. Educational programs leading to degrees of different character, such as degrees in engineering and in fine arts, are described with similar keywords such as design, product and industrial design. This is also shown by the Swedish government's proposal\(^5\) for reorganization of the comprehensive upper secondary school in which Technology and Design is the name of one national specialisations of the Technology preparatory programme for higher education.

It might seem that there is confusion in defining the concepts of technology and design, but it may also be that the interpretations of the concepts are changing. When educations of engineers and designers, particularly education of industrial and product designers and engineering towards the manufacturing industry, are becoming more similar one might ask if this will lead to a stronger or weaker technology education.

**Repertory Grid Technique, a tool to derive technological knowledge?**

The idea of this research project is to turn to experts, people who are actively engaged in a profession that involves engineering or design, and to search and compare their expertise in order to find information useful in the development of technology education.

When we master something well Ryle (1949) argues that knowledge becomes tacit. This correlates with Dreyfus and Dreyfus (2000) description of intuition as ability experts use when they make decisions. Björklund (2008a) describes this by explaining the intuition as a result of knowledge from an unconscious learning system that store and compare patterns. The system learns slowly, but the knowledge is left for a long time. Experts use this system, but because learning is unconscious, it is difficult for them to describe their skills and they refer to intuition or gut feelings.

When the aim is to derive knowledge that is implicit and hard to express, the choice of method is of significance. Repertory Grid Technique has been used by Lars Lindström (2003a) to examine criteria used by professional artisans and educators when assessing craft products in terms of novice or expert.

The method seems interesting because of the possibility of obtaining an understanding of how the interviewees see and judge their own reality while minimizing the risk of influence by the interviewer. It also provides the ability to use artefacts in the study, which is appropriate

\(^3\) http://vaio.sony.co.uk

http://www.apple.com/

http://www.motorola.com/

\(^4\) http://www.regeringen.se/sb/d/1928/a/19728 (in swedish)

\(^5\) http://www.sweden.gov.se/sb/d/10086/a/101962
considering the special knowledge of artefacts that designers and engineers have. As de Vries (2005) describes, artefacts are also carriers of knowledge. This knowledge can be read by some.

“When designing an artefact the designer uses these various types of knowledge. It is thanks to this knowledge that artefacts become what they become. One could almost say that the knowledge has been 'absorbed' by the artefact. And someone using the artefact by examining it closely can sometimes recognize what knowledge probably has been used to determine the shape and the materials of the artefact. But for someone not having the expertise to recognize what knowledge is in the artefact, the knowledge has just 'disappeared'. The knowledge is now as it were embodied in the artefact” (Ibid. p.38).

If it is possible for some experts to derive understanding out of artefacts, what kind of knowledge does they possess? In the case of engineers and industrial designers, technological knowledge, de Vries suggests that the characteristics of this knowledge are;

- Knowing How (Ryle,1949): implicit skills
- “[…] knowledge that needs to be visualized.” (de Vries, 2005, p.32): knowledge as expressed by sketches and drawings and are difficult to express in other ways
- Normativity: to have the ability to make correct choices and judgments about artefacts, e.g. the ability to use the right material to achieve a specific function

The theory behind Repertory Grid Technique

The original method is devised by George Kelly and is based on his Personal Construct Theory (Jankowicz, 2004). Kelly (1963) compares the motivation of all humans with the motivation he suggests is the driving force for scientists, to predict and control. Each individual tries to construct a rational world based on their experience. Our experiences shape a pattern which Kelly calls constructs. With time more constructs will be added and old ones modified. Finally, each individual person holds a complex and unique set of constructs. With these, we try to predict and interpret events and understand the world around us.

There is no guarantee that we will reach the same conclusion as another person, even if we experience the same event. This is because we interpret the world using our total sets of constructs. It is not the common experiences of events that make us similar to other people but the way we anticipate events. Our actions are similar to those who interpret the experience in the same way as we ourselves do.

“People belong to the same cultural group, not merely because they behave alike, nor because they expect the same thing of others, but especially because they construe their experience in the same way. (Kelly 1963, p.94)”

When Anne talks about her friend Mary, saying that Mary is nice, Anne means that Mary is nice in contrast to something else. Nice can for example mean that Mary is not unpleasant but it can also mean that she is not particularly charismatic. To get a better understanding of another person's way of seeing the world, according to Kelly, both poles of a construct need to be known.

The elicitation of constructs with Repertory Grids

One way to better understand a persons constructs is to use Repertory Grids. The point of using Repertory Grids is to minimize the influence of the interviewer. The interviewee or the interviewer in collaboration decides a topic to discuss. If the theme of the interview is friends some of the interviewee’s friends are chosen. They are the elements and represent the topic
friends. A selection of three elements is made by the interviewer and is presented to the interviewee. The interviewee has to choose two elements that have something in common which the third element does not have. If Anne is interviewed and the topic is friend she might say that Mary and John are nice and Sally is not. This is the elicitation of one pole of a construct but it would not be complete without the other pole. Anne will now describe the attribute that Sally has that is contrasting to nice. If she says that Sally is unpleasant compared by the other two, the two poles of the construct is nice and unpleasant. Anne will then rank all the elements, her friends, according to a scale. The procedure continues until it is no longer possible for Anne to elicit more constructs. This is in general terms how the elicitation of constructs with Repertory grids are performed.

All the elements, constructs and figures are ordered in a grid. The elicitation procedure and the generation of the grid can be done using computer software. Despite the quantitative structure Jankowicz (2004) describes Repertory Grid Technique as a mainly qualitative method whose main aim is to understand other people, not to fill in numbers in a grid.

**An interview design with the Repertory Grids**

People are not the only entities that can be used as elements. Jankowicz (2004) gives examples of artefacts such as food and car brands. Lindström (2003a) uses works made by artisans and students as elements and Björklund (2008b) uses artefacts made by pupils during lessons in technology.

These earlier works as well as de Vries description of artefacts as carrier of knowledge have influenced the design of this study. The idea is to let experts examine and compare artefacts with the Repertory Grid Technique and then by further analysis, let their constructs highlight the knowledge that they have read into the artefact.

**Selection of artefacts**

Artefacts are selected in advance by the interviewer and chosen carefully in order to represent a variety of materials, forms, expressions and functions. The objects are a bicycle helmet figure 1, a Christmas tree ornament figure 2, a watering can figure 3, a pair of revolving punch pliers figure 4, some cutlery figure 5, a cigar box figure 6, a multiple socket figure 7 and a reindeer figurine figure 8. The choice to use artefacts selected by the researcher is not part of the original design of the method, but it is a decision taken in order to facilitate comparability between the interviews.

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6 http://repgrid.com/
Informants and interview settings
Five interviews with five industrial designers are conducted so far and 50 constructs are elicited, the average time for an interview is approximately 1.5 hours. The interviewees have different length of work experience, from more than 20 years to just a few years in the profession. Everyone has a degree in industrial design and one also has a degree in engineering. Some of the interviewees are employees and some are entrepreneurs with or without employees.

The interviews are conducted at the workplace of the interviewees. This provides a suitable environment for interviews about the interviewees’ work and also gives the interviewer the opportunity to see their work environment.

The informants in our pilot study are told the purpose of the interview, to examine occupational knowledge. They receive a description of the procedure for the elicitation of constructs and how they, themselves, will perform this procedure with the help of artefacts. They are also told that the focus is on them as professionals and that the topic of the interview is products.

Elicitation of constructs from the interviews
Notes during the elicitation of constructs, figure 9, are made by hand by the interviewer in order to let the informants feel that the focus is on him or her and not on the method. The interviews are recorded and the data are later entered in the software with the recording as verification if something is unclear.
Figure 9 shows notations from the elicitation of constructs. The notations are translated from Swedish by the author. Elements are above the grid and the poles of the constructs on either side of the grid. Scale used in this example is graded 1 to 5. Template for notations is taken from Jankowicz (2004, p.25).

(1) The artefacts that have been numbered in advance are placed in front of the interviewee without description or name. Some informants find the objects amusing and the process a little odd. This is not a disadvantage, but helps to ease up the mood. (2) The interviewer presents a triad of artefacts to the interviewee and asks her or him to choose two that have something in common which the third artefact does not have. (3) The interviewee describes this something and puts a name on it. This is the emergent pole of the construct, the explicit characteristic of the construct (Jankowicz, 2004). The third object is in contrast to the other two; this contrast is also described and named and becomes the implicit pole (Ibid.) of the construct. The implicit pole makes the construct complete and gives it its more specific meaning. The implicit pole would have been tacit if not exemplified by the third artefact. The interviewee has now elicited a construct. (4) The interviewer writes down what the two artefacts have in common to the left and the contrasting characteristic of the third artefact to the right of the grid sheet, see Figure 9. (5) The next step is to rate all the eight artefacts according to a scale of 1 to 5 where 1 represents the left pole of the construct, the characteristic of the two artefacts, and 5 the contrasting pole, the characteristic of the third artefact.

Figure 10 shows the construct “The design is guided by the shape” versus “The design is guided by the function” and that the Christmas tree ornament is rated to 2. The interviewee values the artefact, from an industrial designer’s point of view, to be a product designed with a focus on form rather than on functionality. The pair of revolving punch pliers on the other
hand is rated to 5 which mean that the interviewee considers them to be designed with functionality in focus.

Figure 10

Figure 10 shows a Repertory Grid generated by Rep IV. Elements are below the grid and the poles of the constructs on either side of the grid. Scale used in this example is graded 1 to 5. Data are from the author’s own research. Translation from Swedish is made by the author.

A new triad is shown to the interviewee and the procedure of eliciting constructs and rate artefacts is repeated until ten constructs are elicited or until the interviewee no longer is able to elicit unique constructs or just does not want to proceed. Jankowicz (2004) recommends at least seven to ten constructs to get a varying picture of the informants view on the topic but more constructs can give better information. The decision of ten constructs has been implemented as a result of the interviewees’ limited time and to facilitate comparability between the interviews. This proved to be an appropriate number of constructs as it is a tiring procedure to elicit constructs and that the interviewees had difficulties eliciting new constructs at the end of the interviews.

Analysis

Repertory grids can be analysed with a variety of methods. The focus of the analysis is on the constructs since all the elements are pre-selected and not chosen by the interviewee. This overview will describe Eyeball Analysis, Cluster Analysis and Principal Components Analysis, which all give good information about constructs.

Eyeball Analysis

This is a first step, a basic analysis and overview as a first reflection in order to familiarize oneself with the grid, see figure 10. We address the questions: what are the constructs, what rates do they have, are there differences and similarities between the constructs and are there some that stand out, elements that mostly received 1s and 5s? Is it possible to interpret the interviewees understanding of the topic through the constructs?

Cluster Analysis
Figure 11 shows a cluster analysis. The order of the elements and the constructs is changed in comparison to Figure 10. The new order reflects the differences and similarities in the rating of the elements and the constructs.

The cigar box is closely matched to the cutlery but not with the multiple socket. This is also shown by a dendrogram, the tree-shaped lines located above the grid. The dendrogram shows that, the cigar box, the cutlery, the Christmas tree ornament, the watering can and the reindeer figurine form a cluster. The multiple socket and the revolving punch pliers also represents a cluster, but the bicycle helmet is alone. To the right of the dendrogram is a percentage scale. The scale shows that the similarity between the multiple socket and the revolving punch pliers are just below 90%.

The dendrogram to the right of the grid presents the similarities between the constructs. The constructs “Form and function in balance” versus “Not complete, not finished. Unbalance” and “Must meet many requirements” versus “Artistic freedom / not many requirements” form a cluster with resemblance at about 75%. “Organic” versus “Angular” stands alone and the rest forms a cluster where “Pretty” versus “Ugly” and “Quality, aging beautifully” versus “Not quality” have a similarity at over 90%. “The design is guided by the shape” versus “The design is guided by the function” and “Entertaining” versus “Suit to its purpose” have also a resemblance at over 90%.

The data indicates that the interviewee is under the impression that an ugly product is a product without quality and a pretty product can be one that have quality and aging beautifully; as well as, a product with a design guided by the shape can be entertaining and that a product with a design guided by the function is one that is suited to its purpose.

Figure 11 shows cluster analysis generated by Rep IV. Elements are below the grid and the poles of the constructs on either side of the grid. Dendrogram above the grid shows the percentage of similarity in ratings of the elements. Dendrogram to the right of the grid shows the percentage of similarity in the ratings of the constructs. Data are from the author’s own research. Translation from Swedish is made by the author.

Principal Components Analysis
Figure 12 shows a principal components analysis graph. The vertical and the horizontal grey lines represent two distinct patterns of the ratings and are called the two principal
components. These two components account for 83.6% of the variance. The elements and the constructs are placed in relation to the two main components. The constructs poles are linked with a line. If a construct is close to one of the components there are similarities between them. If constructs are close together they have similar ratings.

Figure 12 shows that the construct “Nostalgia, sentimental value” versus “No feelings to the product” is close to component 1. “Form and function in balance (Complete product from an industrial design perspective)” versus “Not complete, not finished. Unbalance” is close to component 2. One way to interpret the principal components is that one is about feelings associated with the products and the other towards the striving for balance in the product. This interpretation is evidenced by the grouping of constructs, further on called A and B.

A.
“The design is guided by the shape” versus “The design is guided by the function”
“Entertaining” versus “Suitable to its purpose”
“Thoroughly worked form” versus “Form result of construction”
“Must meet many requirements” versus “Artistic freedom / not many requirements”

B.
“Quality, aging beautifully” versus “Not quality”
“Pretty” versus “Ugly”
“Pleasant experience (Soft charisma)” versus “Unpleasant experience (Hard charisma)”

Figure 12

Figure 12 shows a principal components analysis graph generated by Rep IV. The vertical and the horizontal grey lines represent component 1 and 2. Elements (red dots) and constructs (blue crosses linked with a line) placed in relation to the two main components. Data are from the author’s own research. Translation from Swedish is made by the author.

Advantages and disadvantages of Repertory Grid Technique
As previously described (Björklund, 2008b; Jankowicz, 2004; Linander, 2002; Lindström, 2003a) there are general advantages with the Repertory Grid Technique, like a more active role for the informant and reduced influence from the researcher. On the other hand the method is time consuming, this makes it difficult to generate large amounts of data and thus produce general knowledge.

In this particular study the elements have been selected in advance by the interviewer. This influences the informants and some of the possibility of deep understanding of individuals may be lost. The pre-selected elements are still used because the study was not designed to understand personalities, but to try to explore knowledge in certain occupations and to compare them. Since the interviewees are working with artefacts and hold technological knowledge, our assumption is that they would have a special relationship and a special knowledge of products and the ability to read them.

It is possible, if desirable, to go deeper and receive more knowledge with the repertory grid but the fact that the method is time consuming is in our opinion an important matter. Since the interviewees are working and do not have much time, is it difficult to require that they spend even more time on the interviews. For further deepening of the informants reality there is more material on the recordings. This data could be analyzed with phenomenology or narrative analysis (Bjurulf, 2008) and provide a broader picture of the interviewees work and work environment. If more quantitative data is wanted, information from the analysis of the grids can be used to create questions for a questionnaire.

Future directives include tasks towards finding a good way to compare data from the various interviews. Jankowicz (2004) suggests content analysis in which data are broken down into categories, instead of doing analysis based on the ratings. It is our belief that ignoring the ratings and instead using categories is not optimal. Since all elements are the same in all interviews it will be exciting to see and compare the elements ratings and formulations of constructs. This information can then be a basis for creating categories.

In conclusion the Repertory Grid Technique is in our opinion a useful method and reveals information that otherwise might be difficult to obtain.

References


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