ERRORS AND FUNCTIONAL REASONS IN ARCHITECTURAL DESIGN

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Abstract

Designs are representations of contents whether they exist in the mind or on paper or, eventually as artefacts. As these contents can always be reduced to thinking, it is important to understand the ways the mental contents are organised. The organisation of mental contents has been studied in gaming environments, especially chess. However, we assumed that a richer environment could give us a more thorough picture of the process. We chose to study the processes organising mental representations in architectural design because it is a rich enough task environment to allow for an almost limitless variety of solutions, but yet provides some issues that can be identified as correct or incorrect.

We found that content organization in an architectural design process is mostly governed by domain-based functional reasons such as “I will place a huge window here to get the most of the view”. The results implied that these are a very important type of reasons. However, some of them do not make sense in the architectural context despite their apparently correct form. We called these reasons pseudo-functional and observed that whereas functional reasons are proportionately less common with novices than with experts, pseudo-functional reasons are five times more common with novices than with experts. This points to a tendency to explore and use reasons of the correct form whether the reasons themselves are correct or not.

Key words: error, functional thinking, expert, novice, architecture, design

Introduction

Content-based psychology offers one perspective to studying thinking in design. One of the central issues in this approach is the relationship between the information contents and content structures, and mental representations. The key issue of this paper is to shed light on how the contents and content structures are incorporated in the mental representations and what kinds of rules govern this process. This is most important, because representations are used to explain human behaviour.

Designs are representations of mental contents whether they exist in the mind or on paper or, eventually, as artefacts. Nevertheless, representations and the process in which they are created can always be reduced to thinking. Therefore, it is vital to the study of design to understand the ways the mental contents are organised in thinking, because thinking governs the way we design.

The organisation of mental contents has been studied in relatively large task environments such as gaming environments, especially in chess (Saariluoma 1990, 1992; Saariluoma and Hohlfeld, 1994; Saariluoma and Kalakoski 1997, 1998). This is a natural starting point, because thinking essentially involves arranging content elements in another order.

The crucial point in all design is the forming of representations. We call this stage apperception, because it can be argued on conceptual grounds that the process of selective abstraction is a specific aspect of the general process of apperception

(Saariluoma, 1990, 1992, 1995, 2001; Saariluoma and Kalakoski 1998). Apperception is a name for a process that enables people to incorporate issues like world-economy, possible, and infinite into their mental representations, even though none of these can be directly perceived. This process makes it possible for the human mind to incorporate this non-perceivable, but nonetheless important information into representations, and to integrate sensory information with conceptual information in the memory (Kant, 1781; Miller, 1993; Saariluoma, 1990, 1992, 1995; Saariluoma and Hohlfeld, 1994; Saariluoma and Kalakoski, 1997, 1998; Wundt, 1897).

Apperception research has revealed that chess-players’ moves in their mental problem subspaces are generated in accordance with certain reasons. These reasons explain why a certain move belongs to a particular representation and the subsequent action (Saariluoma, 1990, 1992; Saariluoma and Hohlfeld 1994; Saariluoma and Kalakoski, 1997, 1998). Chess moves are generated from a huge set of possible moves. Senseful moves form only a subset of these moves, whereas the rest are senseless. Therefore, chess moves provide us with a model of content-based explanations in a large gaming task environment.

The task can be described as a tree of possible states in which one proceeds by doing operations manipulating these states (see de Groot, 1965, 1966; Newell and Simon, 1972; Saariluoma, 1995). Especially the modern subspace-abstraction-based versions provide many good conceptual opportunities to analyze cognitive errors in design (Saariluoma, 1990, 1995). The tree is seen as an analogy for making hierarchically organized choices, which lead to the expected solution if the choices are correct.

Based on these models, it can be argued, that each move has a function that is defined by its content-based purpose. Thus, the content-based reasons for precisely that move can be regarded as a clue of a more specific content-class. This is the class of functional structures, i.e., the class containing moves that are intended to serve a specific purpose (Saariluoma, 1990, 1992, 1995). As this class is so evident in the problem-solving environment of games, we have reason to assume that it may exist in other problem-solving environments as well. We know for example that architecture and engineering claim to create exactly those items that are based on fulfilling functional uses and rules (Freeman and Newell, 1971; Saariluoma & Maarttola 2001).

A richer task environment such as that of architecture may give us a more thorough picture of the representation forming process than gaming environments. We chose to study the processes of organising mental representations in architectural design because it is a task environment, which is rich enough to allow for an almost limitless variety of solutions, but yet provides several issues that can be identified simply as correct or incorrect.

Our hypothesis is that the components of designs or plans are not arranged at random, but nearly always form a whole. This whole is a composite of sensefully arranged contents in a hierarchical and senseful relation to each other unless a false solution is chosen during the design process. Understanding the sense behind the existence of components in a design may give us insight into what the organising principles of the specific representations forming these particular components are.

Firstly, we wanted to find out whether the skill of identifying and naming objects, and whether the levels and types of explanations correlate with the use of some specific type of explanations. We approached the task by studying first how skilled people are at naming objects, their parts, and what kinds of explanations people give to items shown to them as pictures.

Study One

Subjects

There were three subject groups the first of which consisted of novices, the second group of architectural students and the third group of expert architects. The novice group consisted of three female and three male subjects between 27 and 47 years of age (median age 30 years). The students of architecture consisted of two females, the other 22 years and the other 24 years of age, and one male student aged 22 (median age 22 years). The expert group consisted of two female architects, the other 39 and the other 41 years of age, and a male architect 55 years of age (median age 41 years).

Method

We used a think-aloud technique combined with protocol analysis. Think-aloud technique is used as a means of producing data of the subject’s thought process to be further used in protocol analysis. This approach is widely used in various contexts to investigate the psychology of thinking (see e.g. Akin, 1986; Duncker, 1945; Ericsson and Simon, 1980, 1984; Newell and Simon, 1972).

All subjects worked alone with the experiment instructor in a laboratory setting. The subjects were provided with four clearly printed pictures and four interpretationally open ones sequentially. The topic of all pictures was architecture and engineering. On an average six randomly picked items from each picture were indicated by a circle and a line pointing at the item. This was done in order to give the experiment instructor something to prompt the subject with in case he/she found little to say about the picture.

The interpretationally open pictures were ones, in which one could not be sure where the line was pointing because of the poor quality of the picture even though one could see what the picture was of. We used these interpretationally open pictures in order to see, firstly, whether the subjects would attempt to explain the interpretationally open items in the pictures and, secondly, what type of explanations they would use. An example of a clear and an interpretationally open picture are given in Figure 1.

Place Figure 1 here

Figure 1. An example of a clear (picture number 1) and an interpretationally open picture (picture number 6).

The pictures that were shown to the subjects were: 1) a cut-away drawing of a barrel-vault under construction, 2) a cut-away drawing of a cross-vault under construction, 3) a cut-away drawing of a sash window, 4) a perspective drawing of a wooden I-beam, 5) a cut-away drawing of a flat roof structure, 6) a photograph of a gothic cathedral exterior, 7) a photograph of a container-ship, and 8) a photograph of a double-decker flying boat.

The subjects were given one picture at a time and were asked to explain everything that comes into their minds by saying: “Tell me what comes to your mind about this picture”. The instructor was advised not to use wording that would point to the purpose or function of each item such as “what do you think this thing does”, whenever possible. This goal was achieved well. The instructor told the subjects to think aloud throughout the session and prompted them to go on if they fell silent. The sessions were video-recorded in such a manner that the subjects’ hand movements could be seen and voices were audible on the videotape.

Results

First, we wanted to see whether the members of the expert group could recognize and name correctly the objects more often than the members of the student or the novice group. This was determined by counting the times the subject named the object correctly. The results are presented in Table 1.

Table 1
The Mean Numbers of Objects Named Correctly in Each Group

	Number of recognized and correctly named objects	
	M	*SD*
Novices, n = 6	1.83	1.47
Students, n = 3	3.33	2.52
Experts, n = 3	6.00	2.00

It was clear that the experts were generally far more knowledgeable than either the students or the novices in recognizing the objects. We tested the groups for significant differences in the proportions of each class with a one-way ANOVA. It revealed a significant difference between groups in the proportion of correctly identified objects, $F(2, 9) = 4.964$, $p = 0.035$. In a post hoc Scheffe test the expert group and the novice group were significantly different, $p = 0.035$. There were no other statistically significant differences between the groups.

We continued the analysis by using two categories: the basic category and the subordinate category. The latter are divisions of basic classes. For example, a gothic cathedral belongs to the subordinate category of a more basic category of buildings. Based on earlier studies by e.g. Rosch (1975) we could assume, that the experts would have more detailed knowledge of the objects that were shown in the pictures and could hence, name items in them more precisely, i.e., use more terms of the subordinate category. Likewise, we could assume that the novices would be most likely to use basic, vague, or, ostensive, terms. The protocols were analysed in order to find out the number of references made in a subordinate category and ones made in a basic category. The number of items named in each category in each group is summarized in Table 2.

Table 2
The Numbers of Items Named in Subordinate and Basic Terms in Each Group

	Subordinate terms		Basic terms	
	M	*SD*	*M*	*SD*
Novices, n = 6	29.67	15.40	36.50	31.01
Students, n = 3	34.33	0.58	16.00	6.00
Experts, n = 3	59.33	18.82	9.67	3.79

We tested the groups for significant differences in the proportions of both classes with a one-way ANOVA. There was no statistically significant difference between groups in either the number of subordinate, $F(2, 9) = 3.951$, $p = 0.059$, or in the number of basic terms $F(2, 9) = 1.596$, $p = 0.255$. It is, however, clear that the experts could name more items in the subordinate category that required more detailed knowledge more often than either the students or the novices and that the experts used considerably less basic terms than either students or novices.

The protocols were then analysed to find out whether there is a difference in the amount of comments used to explain the objects between the clear and the interpretationally open pictures. Two sum-variables were formed. The first was the sum for each subject of all the comments she made on the clear four pictures and the second one the sum of the comments she made on the interpretationally open pictures. A one-way ANOVA was performed between all groups and no difference was found between the clear and interpretationally open pictures. This was important, because we could now assume, that all of the subjects would attempt to explain the interpretationally open items in the pictures.

Next, based on earlier findings (Saariluoma, 1990, 1992, 1995), we tested whether the expert group would use functional reasons more than the student or novice groups when perceiving architectural or technical stimuli. Had the experts used less functional reasons than students or novices, we would have been hard pressed to extend the finding of the use of functional reasons to the areas of expert understanding of architectural or technical artefacts.

To test this, the protocols were analysed in order to find out the number of references to the functional reasons of the items in the pictures, the number of correctly and incorrectly identified items in the pictures and the total amount of statements. These were coded as correct reasons referring to the function, incorrect reasons referring to the function, i.e. pseudo-functional reasons, and to comments that refer to other issues than the function. These have been summarized in Table 3.

Table 3

Correct and Incorrect Functional Reasons for Each Group

	Mean number of comments		Mean number of correct functional reasons		Mean number of pseudo-functional reasons		Other comments	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Novices, n = 6	225.00	107.07	28.83	15.57	13.33	7.71	182.83	88.04
Students, n = 3	197.67	45.74	39.00	20.66	7.67	2.08	151.00	30.51
Experts, n = 3	103.33	37.65	28.67	11.37	0.67	1.15	74.00	26.46
All, n = 12	187.75	92.61	31.33	15.26	8.75	7.59	147.67	77.31

In a one-way ANOVA test there was no statistically significant difference between the groups in the amount of the mean number of comments, F(2, 9) = 2.098, *p* = 0.179, the mean number of the use of correct functional reasons F(2, 9) = 0.455, *p* = 0.648, and the mean number of other comments F(2, 9) = 2.542, *p* = 0.133. However, there was a statistically significant difference between groups in the number of the given pseudo-functional reasons, F(2, 9) = 4.747, *p* = .039. In a post-hoc Sheffe test the expert group and the novice group were significantly different, *p* = 0.040. Clearly, the expert group used the least pseudo-functional reasons.

Furthermore, the ratio between the use of correct functional compared to the number of all comments was clearest in the expert group. 27.7 percent of their comments were functional reasons. In the novice group this figure was 12.8 percent. The student group used a mean of 19.7 percent functional reasons.

On the other hand, the ratio between the use of pseudo-functional compared to the number of all comments turned out to be the clearest indicator of differences between the groups. The expert group used only 0.65 percent of pseudo-functional reasons. In the novice group this figure was 5.92 percent. The student group used a mean of 3.88 percent functional reasons.

Discussion

The percentage figures point to the fact that experts use proportionately clearly more functional reasons than students, and novices use the least functional reasons of the three groups in their comments. It was also obvious that experts were notably the best group in naming the object as well as the items within the pictures they were shown. Also, all groups did use a notable amount of their comments to explain the purpose of what they were shown despite the lack of prompting to use this form of explanation. This is clearly a sign of the importance of functional reasons.

According to Rosch (1975) the classes have a functional purpose of providing the maximum amount of information with the least cognitive effort. The experts used the least comments to produce the most correctly named items and the least incorrectly named items. They also gave the least pseudo-functional reasons. This would appear to verify that the class of functional structures, i.e., the class containing moves that are intended to serve a specific purpose (Saariluoma, 1990, 1992, 1995) exists in other problem-solving than gaming environments as well.

This test was based on showing readily chosen pictures of objects. We assumed, however, that this setting would restrict our subject's thinking. This is why we did another study with less restrictions. The second study incorporated designing a house with quite few restrictions.

Study Two

Subjects

There were three subject groups the first of which consisted of novices, the second group of architectural students and the third of expert architects. The novices consisted of two female and one male subject between 21 and 26 years of age (median age 21 years). The students of architecture consisted of one female 26 years of age, and two male students the other 26 years and the other 27 years of age (median age 26 years). The experts consisted of one female architect 37 years of age, and two male architects the other 30 and the other 37 years of age (median age 37 years).

Method

We used again a think-aloud technique combined with protocol analysis. All subjects worked alone with the researcher in a laboratory setting. The instructions were given in writing. The subjects were provided with a map of an obviously larger, but not defined scale of the area, 1:500 and 1:200 maps of the site and its immediate surroundings, a photograph of the site, and with examples of the few symbols that were required (see Appendix A). The subjects were instructed to design by making drawings.

The subjects were given pencils, an eraser, an architects' ruler, a drawing triangle, sketching paper and tape. They were instructed to think aloud throughout the design session and were prompted if they fell silent. The sessions were video-recorded in such a manner that the emerging design was constantly in focus and the subjects' voices were audible. The sketches and final drawings were retained for later analysis.

The task

The task was to picture oneself as having been given a plot and having decided to build one's dream-house on it. The subjects were also instructed that in order to get everything done exactly as they would prefer, they would act as the architect in the project. The subjects were told to sketch a house, complete with all rooms, possible auxiliary buildings and, if necessary, vegetation on sketching paper over the 1:200 map. They were also required to name the rooms. Finally, they were told that they could use as much time as they wanted and were asked to begin.

Results

The protocols were parsed into units to be analysed. The choice of units was established according to the goals of the study and the desired grain of analysis. In this study we parsed the protocols into four different classes of comments and their sub-classes. These are listed below with examples of each unit.

1) Definitions of goals

    1.1 True definitions of goals:

        “It would be nice to retain a view to the road, in any case”

    1.2 Untrue definitions of goals:

        “There is no need for a chimney”

    1.3 Hiding the details

        “This is probably too close to the water, but I will not mind”

2) Definitions of elements and properties

    2.1 True definitions of elements and properties

        “I want the outer wall to be made of wood”

    2.2 Untrue definitions of elements and properties

        “I am sure this place requires a post”

3) Reasons

    3.1 Functional reasons

        “The foundation must be made before the walls are erected”

    3.2 Pseudo-functional reasons

        “I will fit a room here even though it is awkwardly separate from the rest”

4) Architecturally irrelevant comments

        “Ehm…”

A true definition of goals refers to reasons that give rise to the following design approach. A combination of these form a part of a mental representation, which can be called “The Grand Goal”.

The definition of a goal can be either true or untrue. Hiding the details is an alleviation of a goal, and may help in producing a plan, but will not serve the purpose of the main goal. In definitions of elements or properties, the comments are simple statements that can be distinguished as either true or untrue.

A functional reason is a true reason that contributes to converting a fact into another fact that is a necessary precondition for the final solution. A pseudo-functional reason is one that has the functional form but leads to a state that cannot be found in the final solution, i.e. leads the search in the task-space astray. Architecturally irrelevant comments refer to a variety of utterances.

We focused on these four classes of comments in our analysis. The correctness of the reasons was, hence, judged by whether they served to create the eventual solution and were true with respect to the given material.

Comparison of groups

The expert group produced a mean of 535 comments, the student group a mean of 287 comments, and the novices a mean of 317 comments. Some comments consisted of more than one of the classes of comments mentioned above. We counted the total number of the comments of each class and sub-class, and the number of the comments of each class and sub-class for each subject. These are presented in Table 5.

Place Table 5 here

We tested the groups for significant differences in the proportions of each class with a one-way ANOVA. It revealed a significant difference between groups in the proportion of functional reasons, *F*(2, 8) = 5.197, *p* = .049. In a post hoc Scheffe test the expert group and the novice group were almost significantly different with respect to the proportion of functional reasons, *p* = .058. Again, the significance of functional reasons indicates that the functional form does play a role in design thinking. There were no other significant differences between the groups.

18.26 percentage of the experts' comments were true functional reasons, whereas the novice group produced 11.58 percentage of these. Furthermore, experts produced 1.09 percent of pseudo-functional comments, whereas the novices used then in 5.01 percentage of the cases. In both cases, the students' results were between those of the novices and those of the experts. The percentages point clearly to the fact that experts use more functional reasons than other groups as well as use clearly the smallest proportion of pseudo-functional reasons.

Study Three

Subjects and Method

We used the same subjects in study three as we had in study two. The subjects were interviewed after the design task, and, hence, we used again the think-aloud technique combined with protocol analysis with the same facilities and conditions as before.

The subjects were interviewed based on their individual action and outcomes of the design task with special attention to the reasons behind their' design solutions. This time our focus on the interview was on whether the design decisions were made after contemplation or intuitively. Our hypothesis was that the more experienced the designer, the worse he/she would be in explaining the reasons for each design choice. This assumption was based on research in gaming environments where experienced players have been found to have difficulties in giving the reasons for their moves (LÄHDE!). The general assumption is that this is due to – in layman's terms – having learned the rule by heart and not actually remembering the rationale behind it anymore.

The protocols of the interviews were analysed and the answer to each question was scrutinised in light of whether the subject could make the reasons leading to the choice explicit or not.

Comparison of groups

The expert group were asked a mean of 14 questions, the student group a mean of 19 questions, and the novice group a mean of 19 questions. The mean percentage proportions of answers with an explicit content were 25.2 % for the expert group, 38.7 % for the student group, and 81.2 % for novices.

We tested the groups for significant differences of the proportions of both explicit and implicit answers with a one-way ANOVA. It revealed a significant difference between groups in both the explicit, $F(2, 8) = 17.796$, $p = 0.003$, and implicit explanations, $F(2, 8) = 7.125$, $p = 0.026$. In a post hoc Scheffe test the expert group was significantly poorer in explicit explanations than the student group, $p = 0.020$ and the novice group, $p = 0.003$. With respect to implicit explanations, the student and novice group were significantly different, $p = .037$. These results corroborate our hypothesis that the phenomenon found in gaming environments extends to design tasks as well.

There were numerous ultimate goals that were explicitly stated in the protocols. As we had confirmed that the experts were poor in stating their design solutions explicitly when interviewed after the task, we wanted to find out whether the ultimate goals could, however, be found from their designs. We counted the statements of each ultimate goal for each subject, and checked from the sketch, whether it could be found there.

In this case there was no statistically significant difference between the three groups. In fact, the experts were best at fulfilling their implicit goals in the protocols despite the fact that they were clearly the worst in explicating their actions when asked after the task.

Finally, we wanted to test how much of the grand goals could be found from the final sketches. We did this by counting the composite goals that could be identified from the final sketches and compared this to the ones expressed in the protocol. Because each subject had given a unique amounts of goals, we counted the ratio between fulfilled and not fulfilled goals for each subject and then performed a one way ANOVA, and a scheffe post hoc test between the three groups. The mean ratios for each group are presented in Table 8.

Table 8
The Mean Ratio Between of Fulfilled and Not Goals

	Mean ratio between fulfilled and not fulfilled goals	*SD*
Novices, n = 3	6.63	0.56
Students, n = 3	21.00	13.81
Experts, n = 3	65.67	23.59

The one way ANOVA was statistically significant, $F(2, 8) = 11.413$, $p = 0.009$. In a post hoc Scheffe test the expert group and the student group were significantly different, $p = 0.037$. The expert group was also significantly different from the novice group, $p = 0.011$. The student group was not significantly different from the novice group, $p = 0.568$.

Conclusions

We found that most comments are statements of facts, and most likely serve the purpose of triangulating the task-environment. These add up to 50.0% of the comments. The second most common category (21.4 %) of fundamental reasons like “I just love the sea” apparently serves the same purpose, but also defines the most important attributes of the “Grand goal” of the design project. However, what these categories of comments do not do is to point out the direction in which to proceed in a search or problem-solving task.

We found that the mental content organization in an architectural design process is mostly governed by domain-based functional reasons such as “I will place a huge window here to get the most of the view”. The results implied that there is an outstanding mean (15.7 %) of such reasons in every protocol. These are supported by task-functional reasons (a mean of 5.7 %), which are basically self-granted alleviations to the task and allow for more freedom in design, even though they are faulty, in principle, as they depend on future design decisions which are not known at the moment.

However, some of the reasons do not make sense in the architectural context despite their apparently correct functional form. We found that whereas functional reasons are proportionately approximately two-thirds as common with novices than with experts, these pseudo-functional reasons are almost five times more common with novices than with experts. This, in our view, points to a tendency to explore and use reasons of the correct form whether the reasons are actually correct or not. In all, a mean of 2.9 % of the comments were of this form.

The novices’ comments were percentually almost as often faulty as they were correct. On the other hand, the experts gave almost two times more functional reasons than false comments. Judging with these terms, the performance of the student group was interestingly almost as good as that of the experts with almost two functional reasons for each faulty comment.

The fact that the students did so well is probably due to the state in their development into experts. As proposed by Dreyfus and Dreyfus (1986, according to Dreyfus 1997, pp. 19-23; see also Johnson, Zualkernan & Tukey 1993; Wiedenbeck, Fix & Scholtz 1993), a novice relies on interpretation-free rules. These are also the issues that can be learned in formal training in architectural education and are often the first concrete guidelines to doing the architect’s work.

As one’s expertise grows, a person will be able to create a hierarchy of the relevancy of the rules and cues that are present, and the expert designer recognizes what the situation and the appropriate action is without having to formulate it step-by-step neither mentally nor verbally. This is probably the explanation for the students having been such an even match to the experts. The experts know without having to, and on occasion, being able to explicate their actions.

Discussion

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Table 5

Mean Numbers of True and Untrue Definitions of Goals, True and Untrue Definitions of Elements or Properties, Functional Reasons, Pseudo-Functional Reasons and Hiding the Details

Subject group	True definitions of goals		Untrue definition of goals		True definitions of elements or properties		Untrue definitions of elements or properties		Functional reasons		Pseudo-functional reasons		Hiding the details	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Novices, n = 3	61.33	58.62	12.33	16.17	156.33	130.49	13.33	9.71	33.67	24.54	16.67	15.95	32.33	3.79
Students, n = 3	73.33	42.55	3.00	1.00	137.33	39.53	3.33	3.06	50.00	12.33	7.67	3.06	12.33	5.86
Experts, n = 3	115.67	24.83	4.00	2.65	291.00	93.47	12.67	11.50	102.67	34.53	6.33	3.21	23.67	24.95
All	83.44	45.57	6.44	9.32	194.89	109.98	9.78	9.08	62.11	39.22	10.22	9.60	22.78	15.59

Table 6

Mean Percentage Proportions of True and Untrue Definitions of Goals, True and Untrue Definitions of Elements or Properties, Functional Reasons, Pseudo-Functional Reasons and Hiding the Details

Subject group	True Definitions of Goals		False definition of Goals		True Definitions of Elements or Properties		Untrue Definitions of Elements or Properties		Functional Reasons		Pseudo-Functional Reasons		Hiding the Details	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Novices, n = 3	18.51	2.17	2.90	1.69	50.67	11.63	4.62	1.89	11.58	1.83	5.01	0.87	6.70	2.93
Students, n = 3	25.30	14.37	1.04	0.33	48.19	15.57	1.18	1.11	17.22	6.81	2.71	1.20	4.36	2.28
Experts, n = 3	20.47	3.32	0.75	0.52	51.18	3.53	2.38	2.08	18.26	6.01	1.09	0.39	5.87	1.48
All	21.43	8.04	1.57	1.35	50.01	9.97	2.73	2.08	15.69	5.58	2.93	1.87	5.65	2.25

Appendix A.

Drawing Symbols Used in the Studies.