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DESIGN AS A COLLABORATIVE PROCESS: A SYSTEMATIC AND CONSTRUCTIVE MODEL FOR DEVELOPING PLAY MATERIAL FOR BLIND/VISUALLY IMPAIRED PRE-SCHOOL CHILDREN

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1. Introduction: The Design Process

The design methods proposed and studied intensively in the last four decades have attempted to methodise the design process into a field of scientific research, within a predetermined layout. The counter argument has been that, methods saw the designer as only a tool in their application and specified how the designer would behave in carrying out the process, in a not always feasible strict layout, meanwhile neglecting the factor of creativity and social implications of the design activity. Nevertheless, some methods were adapted into highly usable techniques, and others were developed into models applicable to specific design tasks, particularly for developing novel product concepts. When fortified with extensive research on an identified problem, and with a specific user group in mind, such a model may be an invaluable tool in problem solving for a designer. This paper will present an application of such a model during a particular design process.

2. Problem Identification: A Specific Product for A Specific User Group

In the case at hand, the user group is blind/visually impaired children of pre-school age. The problem identified is contributing to the blind/visually impaired child's preparation for structured education in school, among blind or sighted peers, by designing a milieu with educational objectives. Piaget and Inhelder's [1997] account of the cognitive development of the child suggests the following developmental pattern:

1. The child achieves *object permanence*, or an understanding of *objects concept*, which means that the child knows that objects continue to exist even if they can not be perceived.
2. This achievement helps the child develop a *sense of self*, or *ego development*, as he/she is now aware of objects as independent of his/her own actions.
3. This triggers *mobility* in the child, as the child moves towards locating missing objects.
4. Through wanders in the environment, the child develops *spatial concepts*.

On the other hand, children born with no sight generally follow a different pattern of development, with delays in physical, cognitive and emotional skills, resulting in delays in a sense of self in relation to the rest of the world [Fraiberg, 1977], which becomes a vital blow to the ability to interact with objects and persons. The research required in addition to extensive reading of related literature, observation and close interaction with blind children in play situations in the nursery and in home environments. This was a difficult task as:

1. The children engaged in individual activities or remained inactive, and did not play or interact with their peers.
2. If they wished to interact with anyone in the room this would be an adult or the teacher.
3. Unless prompted by an adult or teacher, they seldom engaged in play, and seldom handled objects through their own will.
4. If they ever used the toys, it would be for repetitive play, which is a play behaviour that has to be overcome at a certain stage of development.
5. They did not play imaginative games, which indicates delay in symbolic representation.
6. Most did not respond to surrounding stimuli (sound, light, movement, etc.).

Nevertheless each child was a source of inspiration to ideas, as each child displayed individual characteristics and abilities. The research conducted, prompted the restatement of the design problem as: 'To design a milieu that will contribute to the blind child's development of *object permanence*, of a *sense of self*, and of *spatial concepts*'. Observations also showed that, as the developmental stage of the children differed widely, the milieu designed had to offer flexible play possibilities.

3. The Model Employed to Structure the Design Process into a Systematic and Constructive Framework

A model derived from design methodology and devised to structure a systematic and constructive framework towards this particular design task, was worked. Once the problem was identified, and the user group identified, and research of literature and of an observational nature conducted, the design activity could now start according to this model.

Disciplines that Contributed

Input: DESIGN TASK

1. Problem Definition

Determination of the user group (*age, location, condition, assisting persons)*
Determination of the present behaviour/situation
Determination of the abilities of the user group
Determination of the needs of the user group (teachers and parents also included)
Requirements from the product (*function, purpose, medium of use, etc.)*
Expected results/ effects to be achieved

Pedagogics
Educational psychology
Developmental psychology

Output: Problem Identification

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Input: Problem Identification

2. Determining the Design Strategy

Design theory

Output: Draft Model for the Design Process

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Input: Problem Identification and Draft Model for the Design Process

3. Research

Getting to know the user group (*through observations, interviews, surveys)*
Literature review and review on past studies
Product survey
Visits (*to schools and homes, to the experts of the field, to designers, to the industry)*

Design theory
Design practice
Behavioural psychology

Output: Problem Specification

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Input: Problem Specification

4. Establishing Design Specifications towards a Programme

Determination of the design aspects
Cognitive aspects for understandability
Physical aspects for usability
Attracting qualities
Stimulating effects
Stating the limitations and constraints through
Regulations (safety, standards, use, etc.)
Requirements from the product versus Capabilities of the user group

Design theory and practice
Behavioural psychology
Educational psychology
Law and regulations
Manufacturing engineering
Materials engineering

Output: Design Specifications

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Input: Design Specifications

5. Creation of the Concept

Generating ideas (*discussions, sketching, rough models)*
Presenting ideas to the user group for immediate feedback
Selecting one alternative that suits most of the design specifications

Design practice
Educational psychology
Model making

Output: The Final Design Concept

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Input: The Final Design Concept

6. Designing

Refining the design concept through visual communication techniques
Transferring the final design concept into a legible design product
Critiques from and discussions with colleagues
Carrying out further necessary research
Selection of the materials and of the production techniques

Design practice
Design education
Manufacturing engineering
Materials engineering

Output: The Designed Product

↓

Input: The Designed Product

7. Manufacturing of the Prototype

Model making

Output: Prototype

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Input: Prototype

8. Testing

Safety testing (could not be carried out as the model was not a prototype)
Field testing

Safety testing
Behavioural psychology
Clinical psychology

Output: Data Collected from Testing

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Input: Prototype + Data Collected from Testing

9. Evaluation of the Final Project

Evaluating test results and collected data
Interpreting observations
Obtaining opinions

Behavioural psychology
Clinical psychology
Statistics
Educational psychology
Developmental psychology
Design theory and practice

Output: Decisions on Revision

↓

Input: Design Specifications, Concept, Prototype,
Draft Model of the Design Process + Decisions on Revision

10. Revision

Revising the concept
Revising the design decisions
Revising the production decisions
Revising the design model

Educational psychology
Developmental psychology
Design theory and practice

Output: Decisions on Modification

↓

Input: Design Specifications, Concept, Prototype,
Draft Model of the Design Process + Decisions on Modification

11. Correction/Modification

Making necessary modifications
Giving explanations and justifications

Output: FINAL DESIGN
MODEL OF THE DESIGN PROCESS

As can be seen, the outcome of each stage of this model is the input of the following. If there is incompatibility between the output of a stage and the requirements of the input of the next, the decisions and results reveal the need to be reconsidered. This step by step constructive nature of the model thus minimises the risk of decisions that may lead to mistakes. The steps in the stages are determined to assure a certain consciousness of decisions along a linear track, particularly in projects like the one at hand, that search for their own problem identification and a totally novel concept. A cyclic approach on the other hand, may be useful within the steps of each stage of the model, where

the outcome has to be rather specific to provide a basis for the next stage. Nevertheless, the model had to be flexible enough to provide the possibility to return to the previous stages, as the design process requires constant checking and backtracking, true to its interactive and self-evaluative nature. Each step and stage is interrelated towards making of the design process a whole, embodying multidisciplinary information, knowledge and skills, as the chart shows. As the process progresses, the design concept and solutions add onto themselves and the problems are answered in a systematic manner.

4. The User Integrated into the Model as a Structuring and Checking Agent

A main aim of this particular model presented, was to integrate the user group into many stages of the design process.

- In the problem definition; to define the user group with its abilities, needs, the present situation that requires a different design solution, and what effect is expected after the product is used.
- In the research; to obtain information on the user group's development and play skills, related human factors data, and review on past studies carried out concerning similar cases.
- In determining limitations and constraints; to assure user safety with related regulations, and to relate the capabilities of the user group to the requirements of the product to assure a balance within the user-product relationship.
- In the design; to offer a physically and cognitively suitable product and to obtain feedback from samples of users as the design is developed in 3-D form.
- In testing the prototype; to ensure safety through safety testing, and to be able to evaluate the user reaction and interest through field-testing.
- In correcting or modifying conceptual or design decisions after the prototype is tested; to refine the design and better suit the requirements and needs of the user group.

The reason for involving the user frequently in the design process was to ensure the development of a model that might produce an outcome suitable to its requirements when it is finally in relation with the user in a real-life situation.

5. The Project

The project that became the outcome of the design process, is a play system in which several objects are dispersed (Figure 1., left image). The objects had numerous specifications; to name a few, they had to be child-safe to the extreme, has to be voluminous so as not to escape the child's touch, with a possibility of continual curving volume for the stroking or grasping hand of the child. They had to be obliging should the child wish to sit on, or kick, so that the forms had to be appropriately shaped and sturdily built. They had to be versatile in their offer of stimuli: lights, sounds, vibrations, texture, form, etc. The process in the play system was so envisaged:

- ***Stage I.*** The objects send out individual stimuli (such as sounds, lights, vibration, etc.). The child, situated in the milieu, is exposed to these stimuli and understands that there are objects, independent to him/her, that exist in this milieu.
- ***Stage II.*** The child explores the milieu, and comes across the objects in their location. The child picks the objects, explores their properties. The child can put them back in their places or else may collect them.
- ***Stage III.a.*** If the child has collected the objects, the child can return to the center of this environment, where a posting stool is located. Through the slots of the stool the child throws the objects and observes them disappear.
- ***Stage III.b.*** The child may bring the collected objects to the center of the milieu, where, next to the stool is located a big toy dog (Zog). On each of its large legs there are sockets for the objects. The child may place the objects on the legs, and observe the objects become part of another object, defining new spaces for themselves in a new location. The child may be physically active around or on Zog.

- ***Stage IV.*** Together with the teacher, the child may play with the more complex activities on Zog's legs, such as grouping the objects, counting, combining, placing and displacing, matching, etc.
- ***Stage V.*** The child may play imaginative games, alone or with peers.
- ***Stage VI.*** The child may play social games with peers.

The project thus aims at being a play system in which the child can play individually, with a teacher, or with peers, with the flexible play opportunities it offers. The project also aims at demanding activities that become more complex as the child is ready to learn further about objects, space, and what he/she can do to affect them. The project was too large to manufacture and try among children, therefore only Zog, which combined most of the attributes of the other objects was chosen to be constructed.

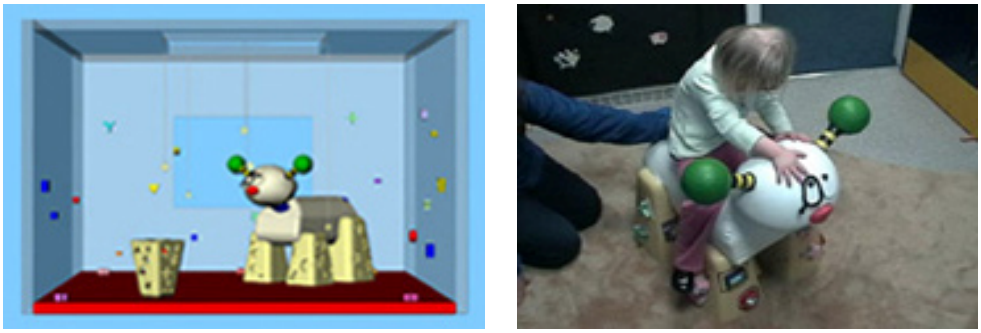

Figure 1. The room, the stool and Zog; child playing with Zog in the nursery

The design project was thus developed through

1. Intense research not only for the problem identification and problem specification but also for design specification;
2. The use of a model with a systematic and constructive framework towards conscious decisions;
3. Regular involvement of the user group in the model, as a structural and a checking agent.

These three factors also determined the way collaboration was to take place with the other disciplines, and the timing of this collaboration. To the process, different persons from different disciplines contributed, at different stages and with different degrees. These contributions were in the form of knowledge, skills, and information. They were what determined the multidisciplinary aspects of this design project. Among the roles of the designer was integrating these contributions into the framework of the model. Deciding on how these contributions were used, also pointed at certain characteristics of design as an activity, as a field of study and as a discipline in its own rights.

6. Field-testing as A Feedback

Zog toy was tested in a playgroup among four children, with the research question stated as 'How do blind and visually impaired children play with Zog specially designed to encourage interaction between a child and toy-objects, within a spatial territory defined around it?' Each child played with Zog in two sessions, to get familiar with it in the first, and to feel more secure and free in the second session (Figure 1., right image). In each session the teacher was present. Although this was not a study that could be statistically evaluated to draw general conclusions from, it was possible to derive the following relationships between the play material and the child:

1. **Discovery - The Child-Object Relationship:** As the children began their first session, they had an initial contact of their own choice with the features of the toy (such as the face, a horn, the body). This initial contact defined a relationship between the object and the child and encouraged the child to begin to explore the properties of the object (***Aim:*** *Understanding the presence of a novel object, co-ordination of fine- and gross-motor skills).*
2. **Activity - The Child-Object-Space Relationship:** Once the children were familiar with their

object of initial contact, they searched for new object possibilities around Zog, and located novel objects or features on it. This relationship required investigation of the toy with spatial search strategies, such as coming into contact with the toy with one hand while going around it; positioning oneself to remember where the object was; and using the features to help position oneself and thus locate the object searched for (***Aim:*** *Spatial awareness, navigation, object location, understanding parts and whole).*

3. **Learning - The Child-Object-Teacher Relationship:** This relationship was what defined the children's play behaviours. Without the presence of a teacher who knew the children, their interests and their abilities, play did not take place at all. The teacher was the encouraging factor ('Shall we find out what it does?' 'Would you help me do it?'), the role model, the emotional support for a child in need of affection or security and the supplier of information (what the toy is, which object the child is contacting, what the object does). She also was the co-operative playmate joining in an activity or helping the child complete it (***Aim:*** *Development of cognitive skills, a basic understanding of the world, development of representational abilities, cause-and-effect relationship, introduction to social play).*

Overall, the children did show interest in Zog as a toy to be explored, spent time trying out some of the activities, and were spatially engaged around it. The toy acted as an object of social interaction between the child and the teacher, and therefore could be used as a learning toy. In the light of the study and with obtained opinions from colleagues, teachers and parents, it was also possible to suggest certain modifications, after which the design of the toy was finalised, once again involving the user group as a main agent in the shaping of the designed product. The field-testing methodology and evaluation and the interpretation of the results once again required collaboration from related disciplines. Multidisciplinarity in these stages of the design process is necessary to ensure correctly applied research methodology, and unbiased and correctly interpreted research results. It also helps offer the research outcome as common knowledge that can be shared with other disciplines in the fields of art, science and technology.

7. Conclusive Remarks

This paper has discussed a study of carrying out a design process within the framework of a model derived from design methodology and devised towards attaining a particular task. The definition of the design problem, and the identification of the user group followed by extensive research on the subject at hand, was at the starting point in the devising of the model. The model both shaped and was shaped by the interactive and self-evaluative nature of the design process. This experience has shown that, the act of design, though independent in the nature of the creative activities that it involves, is simultaneously collaborative in the methods, strategies and knowledge that it requires. Design is not all intuitive creation, though it is that as well; design does use methods and procedures that are in the employ of other fields, thus forming an interdisciplinary terminology or language, which is vital towards establishing a common understanding of the implications of 'design' as such, reflects.

References

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