

# FROM PEDAGOGICAL IDEAS TO A SCHOOL BUILDING: ANALYSIS OF USER INVOLVEMENT IN BUILDING DESIGN

Jiri Lallimo<sup>1</sup>

<sup>1</sup> Centre for Research on Activity, Development and Learning CRADLE, University of Helsinki, Finland

This study explores a school building design project, which was carried out in collaboration between school staff and students, architects, design engineers and other design experts. This study aims to expand the focus from regarding the users as information briefers in early design phases to cover a long-term user involvement in building design. The research data cover a period of four years. The data include formal documents of the project; interviews of the users, architects and representatives of the client; recordings of twenty design meetings (design team meetings, meetings between users, between users, architects and designers), and design documents produced by the designers and the school users. The results help to interpret the design process as co-design, which expands the users' initially abstract and hidden user needs to visible models and designs. The collaboration requires merging of the users' conceptual tools and the designers' concrete drawings and specifications, the structuring of several co-design forums, coordination by the head-user and specific user groups, and tools for individual working and responsibilities. The results can be used to illuminate and to plan user involvement as a heterogeneous and long-term building design activity.

Keywords: building design, co-design, design tool, user-centred design.

## INTRODUCTION

Literature on the user-centred design emphasizes users as a vital source of knowledge and experience for the designer to capture relevant features for the product. A perspective left to lesser consideration concerns user involvement in the course of a long-term, multiform activity between the designers and the users. This study explores a school building design project involving school staff and students, architects, design engineers and other design experts. The project concerns the design of a school for children with hearing and visual impairments, which required a large variety of user knowledge and future-oriented suggestions. As a result of the analysis, a trajectory of collaborative design between the users and designers is presented. This concerns the main phases of the four-year trajectory, and the forums and the tools of collaboration.

## FRAMEWORK FOR STUDYING USER INVOLVEMENT IN BUILDING DESIGN

The interest in user participation in design originates in the studies of developing and implementing information systems at the beginning of the 1960s. In general, a better product quality, meaningful uses of products and user satisfaction have been taken up as positive outcomes of user participation. In particular, in the areas where

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<sup>1</sup> jiri.lallimo@helsinki.fi

technologies mature quickly, designers are turning to the users. User participation has been suggested to be most efficient and influential in the early stages of system development as the costs involved in making changes increase during system development (cf. Ehrlich & Rohn 1994, Noyes *et al.* 1996). Early stage user involvement refers to the actions of 'briefing what the user needs' (Barrett & Stanley 1999; Barret *et al.* 2004; Luck 2003) by asking the users to express ideas and opinions or test single products. After gathering user information, it is the architect's responsibility to create the design concepts and the carry out the design.

Users have also been involved as full design participants in complex services, product families or processes. This study follows the line of Sanders and Stappers (2008) according to which the evolution of the user-centred and participatory design leads to the users becoming partners in co-design, which covers the entire span of the design process. On this basis, user involvement can be characterized as a continuum from informative to the consultative and participative (Damodaran 1996). The results of the studies under the spectrum of user-centred activity, participatory design, co-design or co-creation, all of which have been conducted in the fields of information technology design, systems design, environmental psychology, or facility management, can be used in construction research. In the field of participatory school design, there is a collection of valuable studies, such as the workings of Dudek (2000) and Parnell (2011).

Discussion on user needs prompts refocusing the needs as pre-existing. What if the needs are to be created? Where are they created, by whom, and how do they become design decisions? Joshi and Sharma (2004) suggest that customer preferences evolve in the process of engaging in the concepts, they do not pre-exist. Accordingly, Franke *et al* (2006) distinguish between innovating and non-innovating customers. McDonnell and Lloyd (2014) in their study on the design of a building concept illustrate the importance of the (spoken) articulation of the shared experiences of places and buildings between the users and the architects. Collinge and Harty (2013) underline the role of design artefacts between the users and designers.

The user participation can be approached also from the point of view of potential pitfalls of the design. Much of the users' relevant knowledge may be related to experiences, routines and complex environments, which are so obvious or unconscious that the users are unable to explicate them (Leonard 2002). As a consequent, it may become difficult for the designers to concretize the users' unarticulated practices and needs in their product designs. The user-related problems may lead to overly prolonged or delayed decisions, to difficulties arising from the tendency of sticking to the old or existing solutions, to hold-ups in the process due to rivalling user perspectives, or to prolonged efforts of satisfying all stakeholders wishes. This highlights the importance of coordinative design means and tools, which keep the users' and building design experts' knowledge and requirements as a coherent package.

## **METHODS**

### **Research aim, research questions and methodology**

The aim of this study is to analyse the co-design of a school building, involving the users' attempts to develop their work activities and to design a new school building together with the design experts, whose aim is to produce a safe, user-friendly and cost-efficient building. The analysis expands the focus from regarding the users as

information briefers in early design phases to cover user participation as a long-term and multiprofessional co-design, in which the social and material elements merge. The study sets out to answer the following questions:

What were the main phases of the collaborative design trajectory?

What were the collaborative forums and tools between users and designers?

The methodology must be in line with the aim. In this study, practice-based approach (Miettinen & al. 2009) and cultural-historical activity theory (Engeström 1999) are applied. The activity theoretical framework is used because it seeks to explain the complexity of social and material elements in a given activity, rooted in a longer, historical continuum. Lauche (2005) and Tarbox (2006) subscribe the use of activity theory for studying a design process due to its capability of describing and contextualizing the development of the design practices. Illustrations of the use of practice-based approach and activity theory to study design activities arise from user-innovation in sports industry development (Hyysalo 2009), high-tech development in producer-user network (Miettinen & Hasu 2002), IT-development (Kaptelin & Nardi 2007), or graphic designers' tool-mediated activities (Tan 2010).

The unit of analysis is the collaborative design activity that is object-oriented and artefact-mediated. Object-orientedness is a complex term referring to the subject's (organization, group or individual) utter aim or motive of activity in question. Object in this sense is not to be confused with its other meaning referring to an item or piece, such as in object-oriented programming. The attention is on the historically and socially evolving activity, which is mediated by material representations (e.g. artefacts, tools, instruments, or concepts). For example, the subsequent analysis will show how different stakeholders' participation and their objects of activity are connected in the formation of the complex design-concept, which involves the abstract, strategic aims and materially visualized designs solutions. In this sense, the activity theoretical lens helps to understand how the different subjects' (i.e. participants') objects of activity and the uses of tools are intertwined, fluently or with disruptions.

### **The school community in transition: designing a new building and work practices**

The school under study is a Finnish, state-owned special education school providing pre-primary, basic and voluntary additional basic education. The pupils need support due to difficulties related to vision, hearing, language or interaction. The school offers accommodation services. The initial aim to renovate two separate schools due to indoor air problems was changed 2011 by a decision to build one centre for learning and consulting. The planning of the project started in 2011 and the actual design in 2013. The construction started in April 2014 and the new building will be ready for use in 2015. The investment in the school is 39 million euros. The school design for 140 pupils with a variety of special needs and 230 personnel with numerous expertise areas requires multiprofessional design. It involves the school users (students, teachers, administration, parents, rehabilitation and guidance specialists, staff from IT / kitchen / cleaning / maintenance / etc.) and the representatives of the building project (client, architect/s as a main designer, design consultants, and other experts).

The construction project offers an opportunity to explore the users' participation in construction design, which starts before the actual building project and continues as co-design throughout the project. The user has been heavily involved in the design from the very beginning. In parallel with the building design, the school has been

developing foundations for pedagogy and multiprofessional work. The concept called 'spatial concept' has been vital in guiding the school's internal development and connecting it to the building design. A more detailed view of the co-design forums and design tools will be presented in the results section.

### **Data and analysis**

The research data cover a period of four years and include the formal descriptions and documents of the project, interviews with users, architects and representatives of the client, approximately twenty videotaped meetings (design team meetings, meetings between users, meetings between users and architect and designers) and design documents produced by the school users. The data also cover the school's closed Facebook group where hundreds of ideas and questions were raised, and the school intranet for sharing and commenting on the design documents.

The analysis was started by outlining from the data the formal main phases and outcomes of the design process (e.g. project plan including user requirements, design of massing and space models, detail design). In order to trace the activity, three main categories were used: the activity amongst the school users, amongst the designers, and the shared activity between the users and the designers. According to the activities, the participants, forums, the design tools and the outcomes were traced. For example, in an event called 'architects in the user meetings', the architects, the main user and a specific user-group met face-to-face, and the architects' draft and the users' pre-written requirements were presented and discussed, resulting in a new draft as an outcome. According to the findings, a timeline of the trajectory was formulated.

## **RESULTS**

### **Trajectory, the forums and the tools of the school co-design**

In order to answer the research question '*What were the main phases in the collaborative design trajectory?*' the activities of the users and designers were traced. They had visible trajectories of their own. Also the shared activity was traced, which was occurred as presenting, commenting and constructing new decisions and solutions between the users and the designers. As a result of the shared activity, the users' conceptions of the pedagogy and work, and the detailed requirements for the architect, materials, acoustics, lightning and other elements were embedded in the formal designs.

The trajectory of the design activity is presented in Figure 1. From left to right, the three columns present the activities of the project designers, the shared activities between the users and the designers, and the activities of the users. Due to the focus of the present research, the user activities and shared activities are presented in a more detailed manner. The five main phases extending from 2009 to 2014 are presented chronologically on the rows. The titles of the rows represent the researcher's interpretation of the design phases. The main outcomes are marked in grey. For the question '*What were the collaborative forums and tools between users and designers?*' the results are presented along the main design phases.

	Construction project activity	Shared co-design activity	Design activity at the school
National steering / Planning and benchmarking of school concept	2009-2010		2001 Problems with indoor air occur
	2009 Ministry of education and culture: Report of the national needs for special schools	2010 Decision to merge two schools as a "Learning and guidance centre"	2008 Premise: two schools' renovation
	2010 Ministry of education and culture: Decision to start planning		2009 Schools planning to merge
			2010 National & international benchmarking of other schools
			2010 Courses and training of school design
		<b>Core design idea: 'Out from the classrooms' derives from existing practices, visits &amp; national curriculum</b>	
Project plan / Needs analysis +concept formation	2010-2012	2010 User needs analysis, lead by consultant	
	2011 Ministry of education: Decision to build a new school.	Vision of the work environment	
	Investment decision	Ideal spatial model	
		2011 Project plan	2012 Benchmarking other schools: discussion and reports of ideas
		2012 'Spatial concept' of the school design, with interior designer	2012 Knowledge acquired from several special sources
		Furniture design to meet the spatial concept, with furniture designer	<b>Sharpening the spatial concept: 'From monastery school to innovative -school'</b>
Space and Layout draft design / Concretising spatial concept	I /2013	Architects presenting drafts of functional space design and massing model to head user	Presenting spatial concept to whole staff and parents
		Knotworking for massing drafts	Building cafes at the school
		Architects presenting massing model drafts in user meetings	Negotiation on drafts and spatial concept
	Architects: reworked massing drafts	<b>Users' comments on massing drafts</b>	Users' working on massing model drafts
		<b>Plan with massing model ready</b>	Students working to design: exhibition 'Lets build the school!'
	Project designers' work	Head user participating to design meetings	Staff acquiring individually knowledge concerning their own space
		Meetings with architects, students and staff	
		Meetings between special design consultants and users	<b>Spatial concept capturing three generic activity spaces throughout the school</b>
Detailed design / Concretising space solutions	II /2013	Head user participating to design meetings	
		Architects visiting and discussing everyday work at the school	
	Project designers' work	Meetings between user groups and special designers	<b>Organizing the work of 13 user groups, from architects' suggestion</b>
	Architects's work	Meetings with architects, students and staff	<b>User groups working on their special tasks for Detailed design</b>
		<b>Detailed design ready</b>	
		Spatial concept used to guide design	Spatial concept used in intra-school design and development
Construction / Interior design	2014	<b>Implementation plan for construction ready</b>	<b>User groups working on their special tasks for implementation</b>
	Project designers' work		
	Architects's work	Architects in user meetings: interior design	<b>Students' architecture exhibition 'Lets build the school!'</b>
	5/2014 Construction work starts	Meetings between special design consultants and users	Intra-school work by user groups for interior design
		Interior design with architect plan and 3d model	
	<b>Interior design plans</b>		

Figure 1. Main design phases from the perspectives of the building project organization, the shared co-design and the school user organization

The period during **2009-2010** was the pre-phase for the actual school design, entitled **'National steering'** and **'Planning and benchmarking of school concept'**. The aspiration to renovate or to build the two schools was brought up in 2001 because of the problems with indoor air quality. In 2008, the premise was to renovate two separate schools, but due to the massive renovation costs, the decision was made to build new schools. According to the national alignments for special education, there was a need for national centres for learning and consulting. Negotiations concerning merging the two schools were sealed by a decision by the Ministry of Education in 2010 to start the planning of the construction. It was followed by an account about

costs, site and the initial user needs. The main design forums and tools emphasized the users' own activity. The first steps of joining the ideas of pedagogy and the school building were fed by benchmarking to more than ten other schools' architecture and activity, and courses/training about school construction. The documents, reports and evaluations of the other schools' solutions were important tools to compare the solutions and to discuss them with the colleagues. It was explicitly decided that the pedagogy would drive the building design, not vice versa. The core pedagogical design ideas derived from the national curriculum, the quality criteria for school buildings, and the schools' own pedagogical ideas, which were crystallized in a phrase 'Moving out of the classroom'. Encouraging the staff to collect and share knowledge from the field generated diverse and multifaceted ideas.

**The period 2010-2012**, entitled '**Project plan**' and '**Needs analysis & concept formation**' was relevant for the user due to an extensive analysis of the user activities and the requirements for the building. The user analysis, MyWorkPlace-analysis, was a result of observations, interviews, a questionnaire and workshops, and it was conducted by a consultant hired by the client. MyWorkPlace was relevant in including the work practices as part of the school design. User-activating methods were used, which supported the staff themselves to evaluate the needs for the school space in relation to the existing practices. Based on this, the vision of a work environment and the ideal Space model were produced to serve the Project plan, which included the frame for the costs, amount of space and location. In the project meetings, the head user represented the users. In 2011, the Investment decision followed the Project plan.

Teachers and other staff were continuously visiting schools in order to get and share ideas about school architecture in relation to pedagogy. At this time, the ideas for the multiprofessional practices were taken up. The core pedagogical idea was phrased as 'From monastery school to innovative school' (monastery referring to a traditional, teacher-driven activity), which was re-worked as a design concept together with an interior designer and the head users of the school. The concept combining the ideas of a school building, pedagogy and multiprofessional work was generally named a 'spatial concept' and it was visually modelled as four different scenarios. The scenarios visualized the relations between a traditional school building (with separate classrooms with no other shared space) vs. a new school building (with flexible classrooms and open shared space), and traditional teacher-driven pedagogy vs. student-centred, collaborative and action-based learning. Crucially for the latter design activity, the concept involved a classification of the spatial elements to be used across the whole school; 'Spring' (an area for intensive work; a classroom), 'Park' (an area for open work, a shared space) and 'Den' (a small, covered area for quiet work). Whereas the benchmarking supported diversification of the ideas, the user needs analysis and the formation of the spatial concept helped to ground and focus the users' core aims. This knowledge was also used for the Project plan and space programme.

**During the first period of 2013**, entitled '**Space and layout draft design**' and '**Concretising spatial concept**' the design plans aiming at Functional space design and Space connections design and the drafts for the Massing model were initiated. The designers and the experts responsible for the Project plan were replaced by new ones as a result of bidding. From this on, new architects coordinated the design work. At first, the architects introduced initial models for the Functional space design. According to the architects, this was the first time when the plans became concrete to the user by the means of drafts. Architects and designers worked on the Space model and the drafts of the Massing model but collaboration on this took place between the

architects and the nominated head user of the school. The head user, who worked full time for the project, was responsible for organizing the intra-school design activity and the communication between the users and the architects/designers. The spatial concept was introduced in user meetings as the school's leading design idea and it was discussed by the whole staff. Each staff member was designated to one area of design responsibility. These were 'teaching spaces', 'administration', 'student residence', 'rehabilitation services supporting learning', 'consultancy services', and 'food services'. According to the head user, the criticism from the staff concerning the spatial concept forced to sharpen its rationale. In particular, the ideas of multiprofessional workspaces reducing personal rooms generated tensions and bitter resistance. The head user handled these by explaining the rationale behind the new pedagogical and working objectives, which required more shared spaces. This was linked to the architects' account, which explained the overall space requirements, total amount of space and the budget.

The relation between the spatial concept and architecture was strengthened by the discussions between the head user, the users and the architects. According to the interviews, whereas the users learned about the architectural and material possibilities, the architects understood the requirements from the view of everyday schoolwork. The head user participated in the project design meetings with the architects, designers and the client. Her role was to comment on the plans, to give instant answers or suggestions, or to convey the designers' questions to the other experts of the school. In order for the students to express their opinions on a pleasant learning space, they visited other schools, participated in workshops and eventually started to plan and produce a building design exhibition. The material and the ideas produced by the students were delivered to the architects, who also met regularly. In regular meetings, the students presented to the architects their plans and commented on the architects' drawings. The school design exhibition together with an opera 'Let's build a school!' was presented in the spring 2014. During this period, the user involvement was extensive, as they were encouraged to produce and comment on new ideas.

During the **second period of 2013**, entitled '**Detailed design**' and '**Concretizing the space solutions**', the project aimed at producing detailed designs and implementation plans to be used in construction. For the users, it was time to involve each worker of the community to participate in a user group activity to comment on the architects' models. The multifaceted and detailed design problems led to a formation of specific user groups, following the suggestion of the architect. These 13 user groups were responsible for communication and decision making according to specific spaces, technology or requirements of pedagogical expertise areas. Each group had a leader responsible for delivering the head user the results of the group work. The groups were entitled 'overall perspective group', 'handicraft learning spaces', 'audio-visual', 'school yard', 'spa/pool', 'park area of the spatial concept', 'rehabilitation', 'kitchen', 'consulting services', 'administration', 'home economics spaces', 'arts' and 'accommodation'. In order to finalize the detailed plans, the forming of these 13 user groups was essential. They ensured a focused and a rapid problem solving, and were in constant readiness to take up their own and architects' questions and give comments and make suggestions, even within a few hours' notice. There were a variety of tools that could be used for presenting, commenting, and making suggestions. Mainly, the groups used a document template, which included the description and the aims for the work and the particular questions. The architects worked together with the head user, participated in user group and student meetings,

or visited the particular spaces and facilities of the existing schools (e.g., spaces for physical therapy, swimming pool, classrooms, stairs, kitchen and canteen). At this time, the spatial concept was important in helping the architects to understand the user needs. It was also used to explain the architects' suggestions to the users. As a result, the architects' drawings including questions and suggestions were commented on and modified. The results were delivered to and reworked by the architects until a mutual acceptance was reached. In deadlock or problematic situations due to the missing, inaccurate or conflicting information from the groups, the head user made the decisions.

According to the head user, an important element for the user participation was to ensure the commitment of the staff. This was obtained by obliging each worker to take part in a user group and to sign the outcome documents of the group. This ensured a better time management and personnel involvement in working on the design. Working methods and the use of tools and documents were up to each group to decide, and these included working face-to-face, and on the intranet. The work involved also working with special design experts. For example, in the design of the spa-space, collaboration between the user group, architects, head user, spa-expert, structural engineer, HVAC designers and spa technology suppliers took place. At the end of this period, the designs of the user groups were again merged as one detailed plan, which was finished according to the initial terms and the schedule.

In **spring 2014**, the emphasis was on **the 'Construction'** on site, which started in April 2014 and on **'Interior design'** between the users and architects and with interior designers. For the interior design, the users met several special designers of lightning, technology, acoustics, furniture, decoration, etc. The building information model (BIM) used in the designers' work was also brought for the user. A 3D-videowalking model was constructed from the architect's model to enable examination of the interior between the users and the architects. For example, the model was used to design the signs of passage routes for visually impaired children, the lightning and the interior colour scheme and the usability and safety of the auditorium. In these meetings, the 3D-model was combined with drawings and the real interior materials, which were tested. The period was a phase for opening the design options again, until they became final construction decisions.

## CONCLUSIONS AND DISCUSSION

This study set out to suggest that there is a need for building design research requiring multifaceted and long-term user involvement. The aim of the paper was to explore the trajectory of the collaborative school building design between the users and the designers. The analysis illustrates how the elements deriving and carrying the user activity may become a vital part of building design, when supported by appropriate co-design structure, forums and tools.

The successful turn from taking the user as an early information provider to a co-design partner requires several elements. Co-design is a mutual learning path for users and designers as both try to create their own understanding and ideas in order to reach for shared solutions. The user must have means to make the hidden practices and future visions visible for the development. Also, the user must possess enough knowledge about design and construction, which is relevant for developing the ideas with the designers. Conversely, to be able co-work with the users, the designer must possess means to communicate and develop ideas with them, as stated by Luck (2003) concerning the dialogical participatory design. Organizing co-design requires making

the users' and designers' aims and rationale visible, the structure between users and designers (e.g. responsibilities, division of labour, head user/user groups/ad-hoc groups), co-design forums (between organizations, inside user organization) and the tools for designing and managing the knowledge.

The design process involves several iterations of opening and closing of problems. Users with specific needs may become a heavy burden without the appropriate forums to manage the heterogeneous process. A likely success factor in this project was the structuring of the user participation as part of co-design. First, the head user was responsible for presenting and making the users' voice to be heard to the designers, and for making the designers' knowledge available to the users. Second, the formally agreed bridge between the architects and the head user ensured a flexible means to exchange knowledge and functioned as a forum for decision-making. Third, organizing the specific user groups assured the best available expertise to be reached rapidly. Fourth, inviting the staff as members of the user groups encouraged the participation of individual workers. Requiring that each worker approved the outcomes of the group strengthened the staff commitment to the project.

In this study, the reciprocal development between the users' materialized ideas carried by the 'spatial-pedagogical concept' and the architects' drawings was the spine of the design. With other words, the different objects of activity were merged and concretized as design solutions; the users' drive for new working practices, pedagogy and school building were sharpened by co-design, which mutually fed knowledge for the designers to work on the building solutions. The users needed the architects' and the designers' expertise to concretize the spatial concept and to further use it as a tool for the detail and interior design. The tools, such as drawings, or requirement documents, typically combined the architects' drawings with the users' textual comments or the users' 'drawings-on-drawing'. It was also reciprocal: the architects participated in user group meetings and commented on the users' documents. The significance of the tools relies on their ability of mediating different perspectives and holding the stakeholders' aims and practices together (e.g. Miettinen & al. 2009).

The activity theoretical frame was used to analyse the co-design trajectory and the corresponding practices, forms of collaborations and uses of tools. Its strength is based on offering means to study situational co-design practices as part of a longer historical continuum, in which the stakeholders try to merge their initially separated aims as a new, shared design. Based on the results of this study, planning and coordinating the co-design activities needs to take into consideration the conceptual elements (work visions and concepts), material elements (tools and materialized designs) and the social elements of organizing work between stakeholders. Points of interest for the future studies include how the investment in user participation may result in a more accurate design and reduced design modifications and deficiencies, or in a better user satisfaction. Also, the use of digital design tools (BIM, 3D-models, design games) in different design phases has become technologically available, which offers interesting opportunities. The results of this study encourage future research to explore co-design as longitudinal and heterogeneous activity in order to better understand the meaning and the nature of user involvement.

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