

WHEN ROLE PLAYING IS NOT ENOUGH: IMPROVED UNIVERSAL DESIGN EDUCATION

Núbia Bernardi and Doris C.C.K. Kowaltowski

Abstract

In this paper the principles of Universal Design (UD) are discussed in the context of design education. The application of the concepts of UD to building and urban design has ensured a better quality of life for users with disabilities, however, to create an accessible environment the design profession needs to adopt new attitudes and the design process and its teaching strategies must change. Design education is discussed in relation to role-playing and participatory design activities. A teaching experience is presented, with the goal to develop student awareness of users with special needs. New design communication instruments were developed, such as tactile maps, to enable user participation of the visually impaired. Design is primarily based on visual communication and visually impaired users were included in the teaching experience in view of their inability to evaluate typical design documentation, such as drawings and models. Role-playing, as a means of bringing students closer to the issues of users with disabilities, was shown to be insufficient and the creation of a collaborative design process was important to increase student's sensitivity. The active participation of users with disabilities ensured that future professionals gained a deeper understanding of user needs and were able to create appropriate and quality environment. The inclusion of visually impaired users in the design process is seen as original in design pedagogies. The use of tactile maps for design documentation was shown to be

an important contribution to research in the area of design methods. Some research questions arose from the teaching experience, relating to technical details of tactile map production, as well as pedagogical and ethical issues involved in participatory design.

Keywords

Universal design; architectural design education; design process; spatial orientation; people with visual disabilities,

Introduction

Many efforts have been made in the last thirty years to make the world and particularly the built environment more accessible to people with a variety of disabilities. Regulations and laws have been introduced to ensure that the planning, design and construction of buildings and urban places provide adequately for such users. Barriers, mostly physical, have been removed and research has formed principles and concepts on which to base decision-making in the building industry. Universal Design (UD) has gained importance as a research area.

The training of design professionals, especially architects, has felt the influence of these trends.



Many universities have made efforts to include the principles of UD in their curricula. This educational enhancement is considered important, in relation to job market trends and the globalization of the profession with increased competitiveness. Higher design quality is expected from architects, producing designs that are fresh and new to the problem domain. The new order implies that design students gain a deeper understanding of essential design knowledge. They need to acquire new abilities and attitudes towards design, with an increased demand on being sensitive to user needs. The affective taxonomy of Bloom (1956), based on five levels of development, has for some years been discussed in higher education to improve student's awareness and willingness to receive knowledge. Design professionals should then respond to this new acquisition and value a deep commitment and dedication to what is considered good design. To this effect universities and architecture schools in particular, have introduced new pedagogies and curriculum content.

The synthesis of knowledge, coming from multidisciplinary areas, continues to be a challenge in the typical design-studio of most architecture schools. The studio teaching method relies mainly on the interaction of students with experienced professionals and unstructured discussions concerning the specific, mostly hypothetical, design problems posed. Many studies have examined the typical studio design teaching method in relation to diverse aspects: learning experiences, efficiency, quality of designs, etc. (Carsalade 1997; Oxman, 1999; Gouveia et al., 2001; Rufinoni, 2002; Goldschmidt & Tansa, 2005; Kowaltowski et al., 2006 a; Nicol & Pilling, 2000). Viewing architecture as pure art has often been identified as a problem and

investigations of typical professional practices have uncovered that architects often lack knowledge on, or fail to anticipate, user needs (Nicol & Pilling, 2000; Salama, 1995 & 2005).

In a recent report on design education the essential basic interest and knowledge about human beings is found to be still missing to a great extent in the design profession (Paulsson, 2005). The same report shows that design is too often, unconsciously, based on careless and superficial concepts, and design solutions are essentially based on artistic or economic premises. Importance given to the artistic content may cause architects to ignore social aspects in architecture and to emphasize their self-expression. The aesthetic or formal bias is further reinforced by most architectural publications, used as teaching material in design disciplines. Architectural criticism is virtually devoid of human content and directed towards the formal aspects of design (Kowaltowski et al., 2006 b).

Recent criticism of architectural pedagogy also suggests that schools of architecture tend to use as role models a narrow section of designers, with what may be defined as limited skill-sets, which neglect individual differences of people. In order to encourage architectural pedagogy to become more inclusive, the value of multiple skill-sets should be explored. For instance, the framework of Gardner's (1993) multiple intelligences should have a place in design education. This framework consists of 8 skills: spatial, interpersonal, intrapersonal, logical, verbal, natural, kinesthetic and musical (D' Souza, 2009). Also, if design education is to continue to be relevant to current public and political debates, it must actively re-adjust its focus to give students opportunities to learn more about, both

their discipline and themselves. The questions are: "How can design education respond to this challenge?" and "Where in the curriculum?". With answers to these questions and guidance into these uncharted waters, educators can help students make sense of their work, as well as define their space in the world (Hadjyanni, 2008).

New teaching methods are seen as important to enrich the pure artistic vision of architecture, through the insertion of scientific knowledge and social responsibility. The inclusion of UD in the design curriculum depends primarily on in depth presence of the social science, with a real need to instil sensitivities towards the relation of human behavior and elements of the built environment. To contribute to the discussion of preparing planners, designers and architects in dealing with the concepts of UD in their professional activities, this paper presents a building design education experiment in which role playing and user participation were important collaborative factors in the improvement of design education. To further enrich the teaching experiment the visually impaired were chosen as user participants. Communication in design is primarily visual, through drawings and models, and the participation of people with low vision, or the blind, increased the challenges students faced in the presentation of their design solutions.

Design Education

Most studies on the design process in architecture show that it does not follow rigid rules. Designers do not apply universal methods and rarely externalize their thought process (Kowaltowski et al., 2006 c). Research in design methods consider the creative process complex,

solving what are termed wicked or ill-structured problems (Rittel & Webber, 1973). Thus, design problems are only loosely formulated, at times through a detailed brief or architectural program. Wickedness consists in the continuous redefinition of the problem during the period of its resolution and the impossibility of testing the validity of solutions (Coyne, 2005). A rigid systems view of design cannot be defended, even in the face of losing credibility regarding the design profession, since rationality in design may not embrace important concepts, such as value judgment, context and uniqueness.

Most design education, especially architectural design, occurs through the studio system and how students are stimulated in their design efforts is less related to the pedagogy applied, then to the personalities (instructors) present and their individual ways of approaching design. Schön (1983) describes design as a reflective conversation with the design situation, thus addressing the human thought-processes and the language (drawings and models) used to make design decisions.

In design education, the question of preconception, pre-judgment or prejudice must be addressed, since students, although without previous experience in design per-se, do not come to the studio as a "tabula rasa". The pre-understandings students bring to their academic work come from their personal life experience and studio instructors may attempt, in vain, to free the student's mindset of such presuppositions. A more appropriate approach to design education considers to engage students in questioning such presuppositions, expanding, and at times, rejecting responses in the design dialogue. The engagement of

students in new ideas and concepts depends on how knowledge is disseminated and on objectives and purposes of design work (Snodgrass & Coyne, 2006). Thus, the focus should primarily be on the interaction between man and environments or artifacts and students need to acquire reflective skills, and essential knowledge must include: facts, understanding, skills and familiarity with a subject or concept (Paulsson, 2005).

The Concept of UD in Architectural Education

Since architects are inclined to rely on their intuition, rather than hard science, when it comes to detailed decisions, there is a need to deepen the conceptual knowledge of designers on first principles of many new concepts, such as sustainability and in particular UD. Designing is a form of problem solving and reasoning proceeds from objective and functional assessment to means or (product) design, but does not follow a formal process in which, by deduction, one reaches a logical result from posed premises. This informal practice may cause sidestepping and missing opportunities. Brainstorming or other creativity methods, criticism and decision-making activities should intertwine with traditional design, drafting, prototyping and testing activities to provide the foundation for greater innovation and awareness raising in the building design process. There is also a need to deepen the knowledge of designers in relation to the concept of UD, which up to now has only been touched on in most architectural education. Design education should focus on the strategic, tactical and operational management of a building or urban design process. Productivity and a recognized quality

of design solutions continue high in the agenda of professional practice and of formal design education.

The sensitivity of students has improved in the last 20 years, due to many inclusion programs in primary and secondary education, but is still not fully connected to the, at times, very specific needs of people (Paulsson, 2005). Most students, entering design courses, may have only a slight knowledge about the diversity of human capabilities, such as body functions, cognitive abilities, health conditions and personal interests and ambitions to mention only a few. What is still often missing is knowledge about human senses, and that an impairment or disability connected to one sense, may enhance other senses. Thus empowering design can only occur with a profound knowledge about human capabilities and less on disabilities.

“Design for all”, that is for people of varying abilities, should be the aim in architectural programs or the brief (Hadjiyanni, 2008). The needs of the disabled are often not well formulated and it is important to remember that, for instance, the blind and disabled don't have the same needs. Thus, the information these users give to architects and planners are sometimes confused (Christophersen, 2002).

The reality of a design problem must be brought to the attention of students, and direct or inspire their interests away from what is usually more attractive, the latest shiny architectural masterpiece, hailed in glossy magazines. This can be achieved through student's documentation of the lives of people with disabilities. These experiences can develop the intellectual rigor and motivational skills required to find inspiration in the everyday lives of ordinary people. In many

cases, such activities are the few times during a design course that the eye of an architecture student falls consciously on such mundane objects as a simple access ramp, a public lavatory and the likes. Immersion in reality can stimulate creative solutions, closer to the source of problems. Innovation thus no longer is only a quest to be different, but an attempt to respond critically to everyday problems and challenges (Morrow, 2001).

Morrow (2000) states, as well, that in many architectural circles UD is considered a threat to good design, usually based on the latest architectural esthetic expressions. The restrictions imposed on design by UD, should however be seen as inspirators for new and fresh ideas, no longer only for a few privileged users, but for those with various degrees of disabilities and capabilities. The long term goals in enhancing and promoting the development of "Design for all" issues in architectural education programs, should be that UD perspectives and competences be comprehensive, come naturally and be sustained in the design profession (Paulsson, 2005). To change the typical scenario of higher education, many strategies have been used. Among them are: faculty training; introduction of innovative new courses and the expansion of student design assignments into new fields. Cooperative projects between architecture schools and special user organizations are also encouraged. New teaching methods, such as role-playing have been tested.

Role-playing was introduced in discussion groups in Universities already in the 1980s (Radford & Stevens, 1988; Quayle & Paterson 1989). Ostroff (Welch, 1995) encouraged the development of educational programs for UD in five courses:

architecture, industrial, interior and landscape design, as well as urban planning. Ostroff's proposal included financial support for new educational programs and was inspired by a design studio experiment from the 1970s, when Ray Lifchez (1987) introduced studio consultants and jury members with disabilities at the College of Environmental Design at University of California, Berkeley.

Role-playing is defined as the experiencing of a problem under an unfamiliar set of constraints, so that one's own ideas may emerge and understanding increases. It allows students to interact with others in certain roles. One of the many forms of role playing, empathy exercises allow students to experience the views of a variety of users, with an increase in a student's ability to recognize his/her own and other peoples feelings. In relation to reflection, role playing can be used to diffuse a student's close proximity to a project and engage the student in a more objective and creative mode of thinking (Quayle & Paterson, 1989; Duarte, 2003).

Participation of special users in design classes has also been a fairly long standing pedagogical tool in architecture schools. Paulsson (2005), for instance in relation to thinking of the visually impaired, recommends lectures by vision experts and participation of individual users, explaining their life endeavours and experiences. While experts can bring evidence based facts about the causes and effects of impaired vision, the individuals, affected by this disability, can describe their daily life activities and coping techniques. The introduction of both experts and special users should enhance empathy exercises in the design studio.



Although several schools of architecture will stage studio design projects with users, it is in exceptional cases that the learning participation techniques are a key concern (Luck, 2007). According to Johnson (1979), user participation in the design process is not only a question of an application of some new design method, but should be an aid in the decision-making process, thus representing various viewpoints and enriching design debates. The professional designer must learn to act with ethics and responsibility in serving the needs of others. Thus, user expectations must be guided towards a proper understanding of a design's response to needs, to avoid disappointment and dissolution. The education of future professionals must deal therefore with questions of ethics.

Students need to gain confidence in dealing with conflicting user needs and adopt adequate professional attitudes towards users with varying physical and cognitive abilities. Most participatory design occurs not in the classroom, but in professional practice, with users acting as participants in the design decision-making process (Sanoff, 2000; Luck 2007). Thus, users are no longer mere design recipients, but engaged design decision makers. In design education, where hypothetical problems are discussed, effective engagement is absent and this aspect may weaken the impact of user participation on the design process of students. As stated before, an ethical problem may also arise in raising user expectations through enthusiastic student encouragement, later impossible to deliver. Till (2005) pointed out that in many public works situations consultations with a population have risks. Till called such inclusion of users as pseudo participation, judging such practices as poor in most cases.

The introduction of users with disabilities in a participatory design process usually transcends the dialogue between designers and potential users. The perception of the future built environment usually occurs through the reading of a design, represented essentially through graphic documentation. This graphic representation is specific for each of the traditional phases of a design process (sketch plan, preliminary design, final design and construction documentation), targeting different readers and agents of a typical design and construction cycle. For the users, it is important that the graphic symbols help to understand key aspects of a space, its size and wayfinding within a building complex. Thus, participatory design processes, especially those involving users with visual impairments, must pay attention to these factors and future design professionals must go beyond the usual two-dimensional drawings required in most design studios, to include richer sensorial values in their design representations.

Designing with and for users has become a mainstay of interaction design, to better understand how products and spaces are used and to inform future designs. Training design professionals for interaction design touches on several key issues of expertise: ethics of conduct and representational as well as ethnographic skill development (Luck, 2007). Thus, being able to adequately convey ideas, with respect for others and insight of special needs, is an important pedagogical goal.

According to the UNESCO/ UIA Charter (2009), architectural education requires continuous learning through the interaction of practice and training. Also the application of various

educational methods should develop a cultural richness and allow flexible curricula to be responsive to changing demands. Awareness of responsibilities toward human, social and cultural values is stressed in the charter, as well as understanding professional ethics and codes of conduct. Finally, students need skills with the ability to act and to communicate ideas through collaboration. Speaking, writing, drawing, modeling and evaluation skills are important. The traditional design studio meets some of the goals of the UIA charter, especially with regard to interactive learning between student and teachers.

Creative thinking strategies in design education include visual thinking techniques, unstructured brainstorming and role playing, developing a questioning attitude, thinking in alternatives and engaging in non argumentative conversations (making deals, agreeing to disagree). Architecture students are usually readily open to engaging in such exercises, although not always for the purpose of producing innovative solutions, rather than enjoying the activity per se (i.e. having fun).

Design education must concentrate attention to the application of innovative teaching methods at the analysis pre-design phase and recent design education debates have pointed out that the need for new theoretical approaches to teaching and understanding inclusive design. From this, it follows that inclusive design or UD, is not all 'ramps and railings' and that 'disabled' does not refer exclusively to wheelchair users or 'paraplegics' (Karusseit, 2005). Thereby, the new approach establishes an awareness and appreciation for diversity and design for society as a whole. Furthermore, legal requirements (the

Constitution and National Building Regulations) and their shortcomings should be critically considered (Christophersen, 2002).

From the literature on design education it becomes clear that efforts to introduce the principles of UD responsibly exist, but that most schools have been slow to respond to new influences and movements. Also, no consensus as yet exists of what the best methods are in bringing about a change in attitude in students, reflected in the design quality they produce. Some of the more promising pedagogical methods, which are seen to overcome the difficulties pointed out above, can be participatory procedures and role playing. Both methods are seen as techniques for encouraging reflection in design. Reflection is seen as the reconsideration of an idea or experience and an increased consciousness. Retrospection, introspection and self-knowledge are facets of such reflective act (Quayle & Paterson, 1989). The challenges in introducing all these goals and objectives are great and often academicians are reluctant to add one more issue to be taught in the already overloaded higher education curricula. Incentives should be given and may be linked to service education, seen to provide students with practical and real creative problem solving opportunities (Beaverford, 2006).

A Teaching Experiment

An educational experience is presented in this paper which was conducted in the second semester of 2005 and again in 2006 in the School of Civil Engineering, Architecture and Urban Design of the University of Campinas, UNICAMP, Brazil. A specific course was developed which emphasized the principles of UD. Second year

architecture students primarily participated in these classes and some civil engineering students as well. The course activities included theoretical and practical classes, student seminars, technical visits and a final design project. Practical activities included urban design assessments. Role-playing of users with different difficulties (motor, visual and hearing) was performed (Figure1) and students designed university community service buildings as their final project. Interaction design was included with user participation of several persons with different degrees of visual disabilities.

The goal of the courses was to heighten future design professionals' perception of the

difficulties in incorporating the UD principles into the design process and create a greater awareness and sensitivity in students.

The visually impaired were especially chosen as users in the design projects students developed during the course. The special condition of these users was emphasized to make students rethink design presentation and documentation, traditionally based on drawings, models and other visual iconography.

Three subjects structured the courses: building performance assessment, environmental perception and UD. As pedagogical tools, participatory design methods, role-playing and



Figure 1a.



Figure 1b.

Figure 1: Role-playing activities in a design course with UD in mind. (Source: Authors).

awareness heightening activities were applied. The evaluation of this teaching experiment is seen as a research on the appropriateness of design pedagogy. The study touched on issue of qualitative spatial inclusion and encouragement of students to apply the principles of UD, as well as the development of tools to improve design interpretation by users with varying degrees of visual disabilities.

A further methodological concept was analyzed in the experiment. Through the introduction of tactile maps as special design models, reading and understanding of design solutions by users with visual impairment was assessed. Pseudo-users were present in the study. The design and fabrication of tactile maps was supported by classes on model building. Emphasis was given on the scales of models, materials used, color coding and symbols present. The participating

volunteers evaluated the design solutions and the usability and robustness of the tactile maps or special design models produced by students of their design solutions. A tactile and visual pathway for reading the models was included in all tactile maps of this teaching experiment.

The teaching experiment was finally analyzed as to: assimilation/ perception by students of the principles of UD for a building design project; assimilation/ perception by volunteer participant users of the proposed design solution, through the manipulation of tactile maps and finally evaluation of the usability (handling by users) of tactile maps.

During the second offering of the course in 2006 three groups of students developed three different types of buildings. Project "A" was a public service building, Project "B", a small visiting

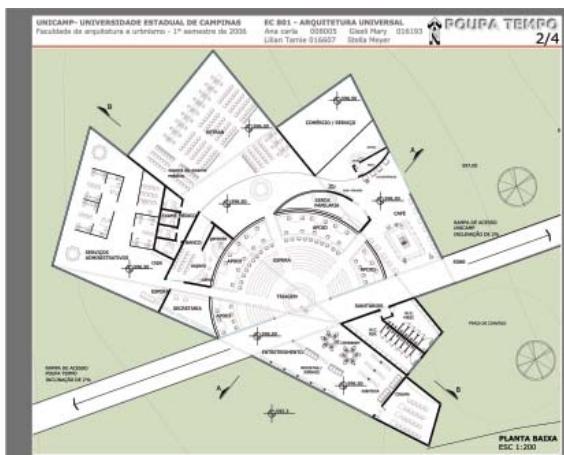


Figure 2a: Ground floor plan of a students' projects for a public serve building for the Campus of UNICAMP.

Figure 2: Example of design project (drawing and tactile map) produced during the teaching experience of 2006. (Source: Authors).



Figure 2b: Tactile map of the service building for the Campus of UNICAMP student project.

professors housing complex and Project "C", a student union building. Figure 2 shows drawings and the tactile map produced by the student group of project "A". Design development proceeded in parallel to the special awareness activities presented above in a typical design studio environment. Instructors discussed the design development individually with the groups and students periodically presented their progress to the class as a whole.

Once the design proposals were transformed into tactile maps, the final participatory phase of the teaching experience started. Volunteer groups, with low vision, analyzed the tactile maps and traditional design models to evaluate their understanding of the proposals. They also evaluated the ease of understanding the tactile maps in relation to colors, materials, symbols and Braille legends used.

During the first offering of the course teachers

learned that such tactile maps must be robust to withstand the typical physical handling during a participatory session. Thus, some types of models were shown to be too fragile and also confusing for people with subnormal vision. Figure 3 shows the dynamics of reading the tactile maps in the participatory process between students and volunteers. The reflection of shiny material of the tactile map, shown in figure 3b, caused confusion with volunteers. Specific color coding of spaces was read by people with subnormal vision as contrasts, not related to the legend used. In some cases, the volunteers confused the tactile route marked on the maps with the wall protrusion indications, making the understanding of the design more difficult.



Figure 3a: Student helping in manipulation of map



Figure 3b: Volunteer using special magnifying lens to help in the reading of the map.

Figure 3: User participation with volunteers with subnormal vision. (Source: Authors).

Discussion

The role-playing exercise was shown to be important to increase students' awareness. On the other hand, limitations in provoking deep-rooted design centered approaches became apparent during this teaching experience. The walk-through and wheelchair exercises brought forward a heightened perception of details, mostly in the form of barriers to students. However, the fact that the exercise was only a role-playing activity became evident when students inadvertently used their own abilities (non-deficient) to overcome obstacles (Figure 1b). These "slips" of behavior as a person with a specific difficulty were in large part unnoticed by students, but in some cases registered in photographs and later commented in diaries and discussions. Further activities must be implemented to bring about changes in professional attitudes in relation to the accessibility issues that transcend role-playing.

The studio design project with specific users taught students and teachers many lessons and gave valuable feed back to students. When presenting their ideas to participating users it became clear to students that their first approach toward designing an inclusive environment were often wrong. They proposed simple, open and flexible spaces, without any encroachments, barriers, columns, level and direction changes. Through this approach students thought they would avoid difficulties for the blind, by removing any obstacle in the day-to-day use of such spaces. However, the visually impaired user needs references for wayfinding and these can be in the form of architectural elements. Flexibility was considered an inappropriate design concept,

since persons with sight deficiencies need permanent conditions to gain confidence in an environment and reduce the need for new learning (getting-around on their own) periods. Also, acoustics plays a role in defining space for such users. The reverberation of sound coming from walls, floors, ceilings define the dimensions of spaces to people without sight. Often such users will snap their fingers in new places to obtain such signals and orient their paces. The introduction of some elements, which enhance such acoustic effects, was also considered important. The introduction of a fountain with water noises could help in wayfinding. One has to remember however that during design phases the acoustics of a space or design solution is absent in design representation and mock-ups are seen as important design analysis tools.

Although the visually impaired cannot see details in the built environment, they often have some discernment of contrast or light. Architecture should therefore use this ability to orient users. Thus, pools of light may be introduced to mark special areas of importance. Color contrast can also be explored to define surfaces. Care must be taken not to confuse users. In the teaching experience described in this paper, students learned that non-orthogonal configurations are more difficult to comprehend by people without vision. The tracing of the wayfinding paths on tactile maps confused most volunteers in the project shown in figure 2. Although the project was organized with a central functional distribution scheme, students had to help volunteers in the manipulation of the tactile map and needed to revert to extensive verbal explanations. This result does not mean that more accessible designs should avoid

radial functional organizations. However, such schemes need careful detailing to improve wayfinding.

The activity of handling of tactile maps showed that the tactile and visual pathway highlighted in the maps occurred efficiently. Additionally, students learned from users, as active partners in the design process. The creative process is no longer a “lonely” activity and students felt more secure in their proposals, since they were shared with users. Subjectivity was reduced and solution justifications were produced with more confidence. The presence of volunteer users with real disabilities heightened students awareness such users encounter in their daily lives and reinforced the lessons learned through role-playing. From this close contact with real disabilities, the true sense of the difficulties of users was made clear.

The teaching experience taught students that traditional ways of design are no longer sufficient. Students noted that especially, other than visual sensorial perceptions must be introduced into design analysis and criticism. A rich diversity of design communication media was considered essential in the new design process with UD in mind.

The participation of users (volunteers) in a learning environment demands new communication skills as well from students. The reading of drawings and handling of tactile maps and models was insufficient in all cases. Verbal communication between students and the pseudo-users was of great help in the recognition of intentions of design solutions. But at times, frustration occurred when verbal and tactile explanations were insufficient. These frustrations alerted

students to design errors and a further important communication skill was learned, that of listening, rather than talking. Several studies, since Schön (1983) have shown that the activity of design is a form of social constructivism and acknowledges that design occurs in conversation. Thus, design facilitation is produced in talk (Luck, 2007). In formal education the opportunities of observing seamless conversations where the users quickly understand the subject being discussed are important, as are the opportunities of performing as design interpreters.

Conclusion

The teaching experience described here was positive in relation to learning levels of students, increasing their awareness and perceptive sensitivities towards accessibility issues. Knowledge on participatory design processes with users with degrees of disabilities was also gained. Role-playing was shown not to be enough and the combination of user participation is recommended. Further research is needed to develop teaching methods to change future design professionals' attitudes towards inclusive design. Studies must be devised to elucidate queries such as: Do students need to come in contact with the principles of UD constantly in their design courses, or is a specific class content sufficient? How can the design process (and the teaching design process) ensure participation of users with different disabilities? More research is necessary to define design documentation for users with impaired vision. Questions should be asked: What scales are appropriate for tactile models or maps? What textures should be used? Where and how can colour contrast be used in drawings? Should drawings use Braille?

The authors have developed several projects aiming to study some of these issues. A campus tactile map has been produced to trace accessible routes for users with varying disabilities, which contribute to strategic planning of the campus and introduce improvements to increase the quality of local university life. Special tools to aid this process may also be in the form of “talking” models or maps, as interactive design tools, and a project in the development of such a tool is at present under way. With the advent of rapid prototyping available to the profession and in most architecture schools today, drawings with textures and information in Braille are more readily produced as well.

Although the results of the teaching experience presented here showed insights from observations of a specific situation in a design class of primarily architecture students, these findings may be meaningful to participatory processes in other situations. The insights gained on the performance of design facilitation can be extended to collaborative design in professional practice and the construction phases of building projects. Techniques for encouraging reflection in design are important to improve both the design and building processes and their inclusion in high education curricula is essential.

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Núbia Bernardi

Núbia Bernardi is an architect. She graduated from the University of São Paulo (EESC-USP), Brazil. She obtained her Masters and PhD in Architecture from the University of Campinas (UNICAMP), Brazil, where she has been a Faculty Member since 2001. She teaches in both the Civil Engineering and Architecture Courses in Design disciplines. In the Graduate Program she advises in the Building Design and Architecture Program. She has developed several research projects in: Universal Design, Tactile and Talking Maps and Design Pedagogy. The major concerns in her studies are: quality of life issues, accessibility in the built environment, and basic design. She can be contacted at nubiab@fec.unicamp.br

Doris Kowaltowski

Doris Kowaltowski is an architect. She graduated with honors from the University of Melbourne, Australia. She obtained her Masters and PhD in Architecture from the University of California in Berkeley. In 2008 she became a Full Professor of Architecture, University of Campinas (UNICAMP), Brazil, where she has been a Faculty Member since 1989. She teaches in both the Civil Engineering and Architecture Courses in Design disciplines. In the Graduate program she advises in the Building Design and Architecture Program. She was the Coordinator of the Architecture Course and the Associate Director of the School. She has developed several research projects in: Building Design and Environmental Comfort, Humanization of Architecture, Design Methods and the Creative Process, as well as Design Assistance for Social Interest Areas. The major concerns in her studies are: quality of life issues in the built environment, social housing, bioclimatic architecture, accessibility, the design process and its pedagogy. She can be contacted at doris@fec.unicamp.br