Transdisciplinary Design Approach

An Experimental Model to Project-based Teaching and Creative Problem Solving

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Abstract. In 1992, the Faculty of Environmental Design at the University of Montreal added multidisciplinary workshops to its academic program with the intention to encourage collaboration and communication between disciplines and to prepare students for the collaborative aspect in their professional life. However, experience has shown that simply joining disciplines is not sufficient. Established boundaries and hermetic discourses that academic disciplines developed over time tend to make collaboration complex and hinder the process of transcending boundaries. This paper discusses inter- and transdisciplinarity in design and describes our experimental project-based teaching model developed for the purpose of conveying methods of creative problem solving while stimulating transdisciplinary thinking.

1 Introduction

The School of Architecture, the Institute of Urban Planning, the School of Landscape Architecture, the School of Industrial Design and the School of Interior Design are all part of the Faculty of Environmental Design at the University of Montreal. They form a gathering of expertise and share a common goal of envisioning and exploring 'the new' and shaping the environment that people live in. Each of these disciplines has its specific area of interest, intrinsic epistemology, methods and language, which are the foundation for a theoretical framework, elevating it to an autonomous system and setting it apart from each other. Despite the common interest that all disciplines

share within our Faculty, they failed to provide a space for communication, collaboration and exchange of knowledge.

Recognizing the need for collaboration and knowledge sharing, the Faculty of Environmental Design in 1992 added a multidisciplinary workshop to its academic program, with the initial intention to foster collaborative and communicative practices between departments within the Faculty, and more importantly to promote exchange among students and teachers from different disciplines.

In later years the multidisciplinary workshop focused its efforts towards better preparing students for their professional careers and a multidisciplinary work environment. This pedagogic structure invited third-year students from all disciplines of the Faculty to participate and to work on a common project.

The workshop in this form (Fig. 1) did not live up to the expectations. Although meant to encourage exchange and communication, the experience exposed fundamental problems, which led to disciplinary clashes. From early on, students did not intertwine, choosing instead to follow independent solving paths, engaging in activities that were familiar to them. Cultural differences and language barriers also made integrative practices difficult. The benefits of the multidisciplinary workshop in this format were therefore not convincing, and required a different format and a revision of teaching methods.

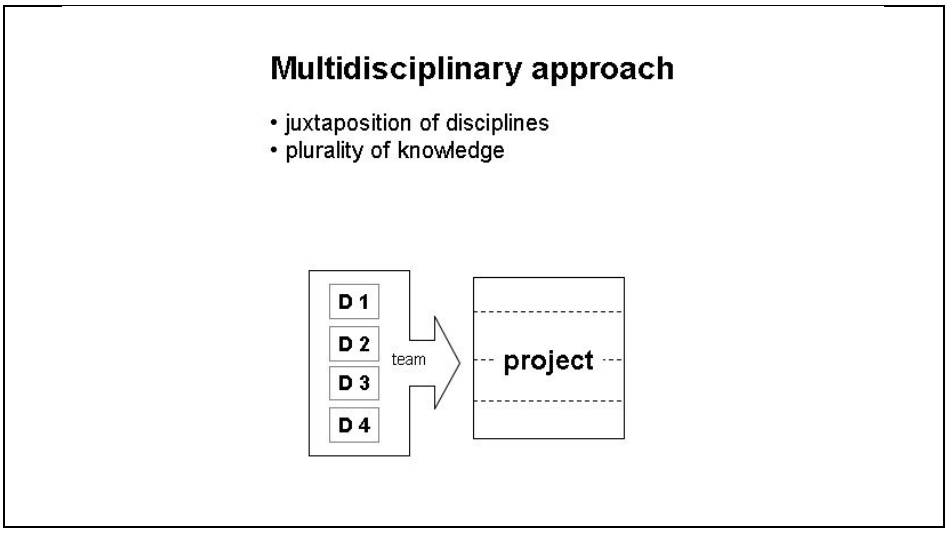

Fig. 1. *Multidisciplinary workshop structure*

The intent of this paper is to critically review the initial workshop structure and its associated teaching approach, to describe an evolved approach to teaching integrative practices, and to argue the need for transdisciplinary thinking.

The paper will discuss the need for an extended knowledgebase, describe the evolving role of design as a cross-discipline, reflect on the integration of transdisciplinarity in design education as well as illustrate these thoughts through a teaching case study. A dedicated section will address the applicability of these

transdisciplinary approaches to other areas such as intelligent living environments and the design of human-computer-interfaces. The paper will conclude with some thoughts on interdisciplinary practices and evaluate the workshops outcome while commenting on the impact of transdisciplinary thinking

2 Extending Knowledgebase

'Various disciplines… over the course of the 20th century became increasingly sub-divided', as Burnett [1] rightfully observed, '… and as they grow more specialized, they cease to see or even envisage the potential connections they may have to other disciplines'. At the same time, modern scientists, such as Morin [2], stressed the need for transdisciplinary thinking, when pointing out that fragmentation of knowledge and monodisciplinarity lead to blind 'intelligence'. By compartmentalizing knowledge, disciplines can lose the ability to contextualize or to position the knowledge in its natural context. In response to the need to bridge disciplinary knowledge, multi- and interdisciplinarity practices have emerged.

Multidisciplinarity is characterized by a juxtaposition of disciplines and their knowledge base, providing multiple views on a subject matter and '…its goal remains limited to the framework of disciplinary research' according to Klein [3]. She further stressed that the characteristics of multidisciplinarity are only 'additive in nature rather than interactive' and lead to 'parallel perspectives' and limited exchange. Interdisciplinary research seeks a full integration of disciplinary knowledge, interactions between disciplines and a transfer of methods. Its 'approaches arise mainly because of a perceived misfit among needs, experience, information, and the structure of knowledge embodied in conventional disciplinary organization,' [3] and thus emphasizing the need of rejecting a singular point of view.

Nicolescu [4] goes even further by suggesting that complex issues have to be tackled from multiple angles, 'regardless of disciplinary boundaries', hence expressing the need for holistic thinking: transdisciplinarity. 'Transdisciplinarity is nourished by disciplinary research; in turn, disciplinary research is clarified by transdisciplinary knowledge in a new, fertile way'.

Transdisciplinarity seeks to transcend disciplinary boundaries and does not content itself with interaction between different disciplines. It is looking for their full disciplinary integration, unifying them as well as their knowledgebase, consequently leading towards a 'new thinking' and towards a new and 'autonomous body of knowledge' [5]. De Coninck [6], however, stressed that transdisciplinarity is not to be considered as a new discipline, but rather as an 'attitude'. 'A perspective of transdisciplinarity arises exclusively from a person's or researcher's own consequent dealing with reality' and therefore relies on an individual's own dynamic cognitive processes [7].

Burnett [1] commented on recent changes in nature and on the role of disciplines and their notable transformation from specialized approaches to integrated strategies, linking different disciplines in research and practice. According to him, the shift from disciplinarity towards inter- and transdisciplinarity occurred as a result of the

alteration of social and cultural conditions for creation and communication of knowledge, driven by the scientific research itself and the proliferation of communication technologies, joining disciplines, such as arts with science.

Even if they all agree that technological innovation is essential for progress in society, many critics reproach that many 'technologically charged products' are mainly technology-driven (instead of user-driven), thus leading to a lack of acceptability by many users [8]. Technology needs to conform to the user, and not the user to technology. This is why, Veryzer [8] insisted, interdisciplinary practices involving not only engineering and marketing but especially industrial design from the onset, can lead to context-sensitive and user-friendly design, more meaningful to the user.

3 The Evolving Role of Design

The role of design is not only to conceive products, environments or services, motivated solely by economic or technological reasons, but also to take into consideration cultural, socio-political, environmental, psychosocial, and ethical issues that preoccupy modern society while exploring new possibilities. Design, should be viewed as 'a way of projective thinking, planning and communicating, not based on a set of universal values and objectives, but on criteria of appropriateness and process quality' [9]. Therefore, design cannot be confined to disciplinary boundaries while searching to 'explore the future and anticipate change' [9].

Findelli [10] stressed the need for a holistic approach in design and the extending of boundaries by emphasizing that 'a design project will more likely produce sense-making results the further one extends the limits of the system in which this project evolves.' He referred to the Bauhaus that understood the need for extending knowledge in design when introducing science such as sociology, cognitive psychology and *Gestalt* thinking [11] to its design curriculum [10]. It recognized that the quality of the physical environment affects people's behavior and psychosocial well-being; therefore, design has to understand what moves people and how they perceive their environment.

Design evolved towards a discipline that is relating and connecting other expert fields, as such; Jonas [12] characterized the role of design as being anticipative, generative, illustrative, use-oriented, context sensitive and especially integrative.

Today, several design schools acknowledge the cross-disciplinary nature of design by adapting design programs accordingly and by creating stronger ties with other disciplines.

Alberta's School of Arts and Design is one of them, having formed connections with other disciplines, such as computer science, engineering, business and marketing as well as social sciences [13]. Nonetheless, many of these collaborative practices still remain pluridisciplinary in nature, meaning that each discipline continues pursuing disciplinary goals and will therefore continue experiencing disciplinary boundaries as an obstacle.

4 Transdisciplinarity in Teaching

The previous discussion emphasized the need for looking beyond one's discipline and inciting systemic thinking. In order to incorporate a transdisciplinary approach in its teaching methods, the Faculty of Environmental Design decided to create a learning environment promoting cross-fertilization.

A broader knowledge and a common conceptual framework would enable students to develop common approaches, and experience transdisciplinary thinking. However, gaining an understanding of a new culture requires immersion. Lacking a common knowledge base and common language -- both of which are essential for communication and collaborative practices -- the initial workshop did not make such immersion possible. The new format of the workshop had to make these fundamentals available to students, and more importantly, provide an environment where divergent thinking and a variety of approaches are conceivable. Therefore, an interdisciplinary approach to creative problem solving was suggested, leading to the formation of multidisciplinary groups, which, after being exposed to each other's domain, were confronted with a real-life problem, allowing students to contribute with their expertise to a common body of knowledge while developing interdisciplinary skills (Fig. 2).

It was important to nurture exchange among students and teachers and promote critical thinking. The overall goal was to experience how 'borrowed tools and methods stimulate cross-fertilization' and how 'new concepts and theories transform the way that objects are treated' in traditional disciplines [4].

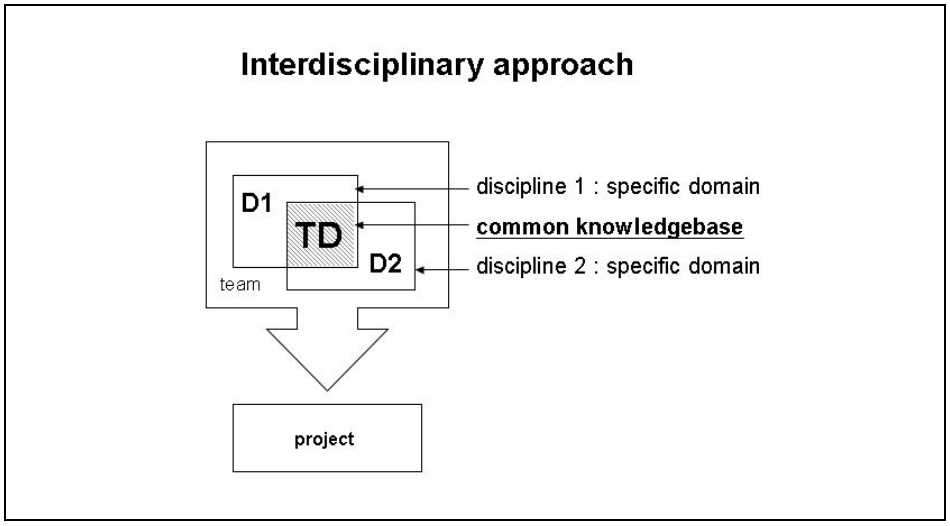

Fig. 2. *Interdisciplinary approach*

The following paragraphs describe the new objectives, the evolved scope and educational structure of the 12-week immersion workshop.

The transdisciplinary workshop was divided into four experience modules: architecture, urban planning, landscape architecture and industrial design. Each experience module lasted three weeks during which the students were immerged in a new discipline. 'Of course, a person cannot be inspired by a domain unless he or she learns its rules.' [14, pp. 89-90]. Therefore, the first effort consisted of teaching students some fundamental rules. Within each experience module, disciplinary notions were transmitted and subsequently applied to project-type exercises. To convey an entire body of knowledge within a three-week period is obviously an impossible task and it was not the objective of the workshop. And so, fundamental theoretical and methodological elements of each discipline were carefully chosen to address the transdisciplinary aspects of the workshop, and were limited to the topics at hand. After completing a module, students transferred to the next, until all four disciplines have been explored. (Fig. 3)

An overall topic, *Nature and Artifice,* tied all four modules together. This topic provided a good opportunity for gauging differences and even oppositions between the different disciplines (and their cultures). It was expected that this topic, from a philosophical point of view, would provoke discussion among all disciplines and stimulate creativity. All subtopics specific to each experience module were governed by this overall theme.

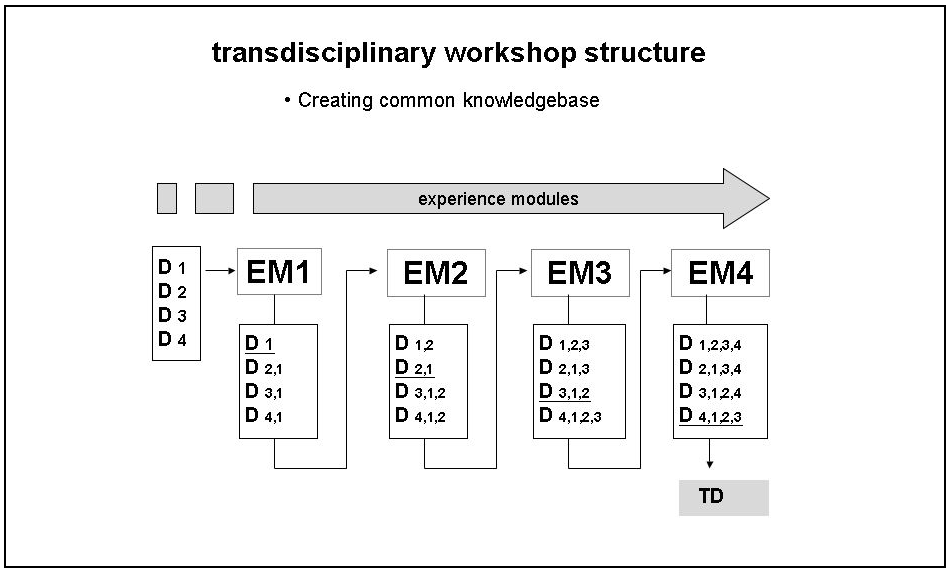

Fig. 3. *Workshop structure, transdisciplinary approach*

Since all experience modules pursue the same goal and follow a similar pedagogic structure, the following sections will describe, as an example, the content of the industrial design experience module, its approach, its exercises and some of the results.

5 Experiencing Industrial Design

The Department of Industrial Design (ID) at the University of Montreal encourages students to adopt critical thinking by teaching creative problem solving and an experience-driven design approach rather than focusing on the product itself, thus promoting a deeper understanding of the user and his interaction within the contextual environment. With this vision in mind, the discipline's theoretical basis constantly evolves to include teachings of elements from other scientific domains, such as philosophy, art history, anthropology, sociology, ergonomics, behavioral and cognitive psychology, and engineering.

The ID experience module intended to enrich students from the other disciplines, but also to bring a whole new educational experience of a transdisciplinary approach to problem solving. Its content was specifically designed, on one hand, to accommodate the short duration of the workshop, and on the other, to control the complexity of the subject matter. This was achieved by proposing a project-based learning and topics familiar to each discipline.

The overall workshop theme was *Nature and Artifice* and the subtopics, specific to the ID module, were: *to illuminate, to circulate and to communicate.* It had been anticipated that looking at a familiar subject from an industrial design point of view would stimulate divergent thinking and foster exchange among disciplines, consequently promising a different outcome.

When approaching these subtopics, students were instructed not to think in terms of objects or artifacts (lamps, signage systems…), but rather in terms of functionality. No other restrictions were given. Economic aspects were ignored. The focus was on methodology, creativity and innovation. The subtopics were only a vehicle, providing context.

Fundamental notions of design were addressed through lesson-type presentations. These included design methodology, cognitive aspects of design and the perception of things, modern design practices, but more importantly case studies that demonstrate how to approach problems creatively and how to convey meaning through artifacts.

5.1 Analytical Exercise

The goal of this exercise was to analyze a situation in an urban environment, to identify and decompose problems, to clarify their relationship, to understand the influencing factors and how they impact a situation, and subsequently, to outline design objectives addressing unmet user needs.

Csikszentmihalyi [14, p.365] explains that 'how you define a problem usually carries with it an explanation of what caused it'. Therefore it is essential to analyze a problem from as many angles as possible.

Students were instructed to adopt a phenomenological approach by focusing on people's experience of the environment (physically and emotionally), by observing user interactions and their relationship with the contextual environment. More specifically, they needed to investigate how things appear to the user, how they are being perceived and how they are being interacted with.

Specifically, this exercise consisted of analyzing one of the proposed subtopics (*to illuminate, to circulate,* or *to communicate*) by using a holistic approach. It required the collection of critical information, observation of a real-life situation and documentation of critical findings. Therefore, it was suggested to explore the city center of Montreal, and especially to envision this exploration as a first-time experience. The following guidelines were given to help structure the investigative process:

1. Identify a specific area of interest and how can or should it be defined?
2. Identify its role, impact and limits. (What does it mean to provide light, to communicate, to circulate, for example?)
3. Identify the users (primary, secondary…).
4. Observe the user experience (considering physical as well as psychological aspects).
5. Consider what may affect the experience (e.g. climate conditions, a specific situation such as rush-hour, stress, tourism).
6. What challenges do or may (some) users face?
7. What conditions need to be fulfilled to make it an efficient, pleasurable or/ and memorable experience?
8. How are those needs met today (*to illuminate, to circulate, to communicate*)?
9. Are there better ways of fulfilling those needs (comparative study, different culture…)?
10. List and prioritize design criteria based on observations and conclusions made.

Comparative studies completed the analytical part of the exercise, leading to conclusions and design recommendations. The findings were summarized and presented to the group using various communication tools: photo documentation, user scenarios, charts, diagrams and information extracted from articles or other sources. Below are a few of the topics that students have singled out and chosen to address:

- *Vertical Circulation*: Analysis of the unique infrastructure of Montreal with its underground system, connecting horizontally neuralgic points of the city: subway stations, commercial plazas, subway system and skyways, office buildings with shopping centers, museums and cinemas. Special attention was paid to the (missing) identifiers for the vertical connections between all these layers: underground, street level and high-rise buildings.
- *To Circulate with Visual Deficiencies:* Analysis of challenges that visually impaired people face everyday while living in a city environment, exploration of sensory needs and how technology integration may address those needs.
- *Street Crossings and Traffic Control*: Study of the effectiveness of the means of enforcing authority and traffic regulations in modern culture.

5.2 Ideation Exercises

Creativity is a mental operation of generating new ideas and concepts and ‘refers to the act of changing some aspect of a domain’ or the way a discipline is being practiced [14 p.291, 370].

Once problems were identified and design objectives established, students were ready to explore ways of solving them. The second exercise consisted of several structured brainstorming sessions, designed to stimulate students to contemplate as many ideas as possible. A panel of ten students was formed and one of them was designated as moderator. Techniques borrowed from the linguistic domain (semiotics, semantics, categorization) structured the ideation session.

5.2.1 Synonyms, antonyms, metaphors

The first part of the brainstorming consisted of generating as many synonyms, antonyms and metaphors (or free associations) as possible for each given keyword (e.g. keyword: inform, synonyms: communicate/ report/ update/ enlighten, antonyms: hide/ conceal/ veil/ deceive, metaphors: sign, message, note, pigeon). Following are some of the terms generated for the '*to circulate'* topic:

- *Synonyms*: move, travel, advance, flow, diffuse, disperse, propagate, spread, disperse, disseminate, distribute…
- *Antonyms*: stop, stagnate, bring to halt, arrest, discontinue, interrupt, hinder, immobilize, paralyze, prevent, suspend…
- *Metaphors*: grid, network, circuit, bypass, moving forward /backward /up-and-down/in circles/not at all…

5.2.2 Categorization

Categorization is a cognitive process of organizing information 'based on semantic coding'. The goal is 'to reduce the infinite differences among stimuli to behaviorally and cognitively usable portions,' [15, 16] and to structure and classify data (terms, objects, concepts…) in form of a semantic web. In our case specifically, it served as a basis for new concept generation.

Students were asked to identify and classify information gathered previously into cognitive structures. It involved grouping the suggested lexical terms into distinct categories that 'appear to substantially share features that show a clear correlation' [17].

The vertical (super-ordinate-, basic-, and sub-ordinate levels) and horizontal classifications provided an extendable information structure (mapping) to which other terms could/should be added, once a logic pattern submerged. For instance, an initial list of users (pedestrians, cars, bikes, trucks) has been later extended by adding: emergency vehicles, tramways, taxi, and isolated as categories with distinctive needs.

This following is an excerpt from the list generated for the '*to circulate'* subtopic.

- *Identification of road users:*
  a) Pedestrians: kids, adults (elderly), adolescents, animals…
  b) Vehicles:
     - Motorized: car, motorbike, emergency vehicle, taxi, van, bus, tramway, subway …
     - Non-motorized: bike, skateboard, roller, stroller, …

  The vertical structure for the road user category included terms such as pedestrian, child, where as the horizontal classification for the pedestrian

category included terms like child, adult, pet… The grouping of users in sub-categories suggested distinctive needs, thus requiring different solutions.

- *Identification of context:*
  a) Street, intersections, walk way, parking lots, boulevard.
  b) Commercial district, office district, residential area.
  c) School area, playground, parks, plaza/squares, bus stops.

  The classification of contextual situations helped identify stakes and specific user needs: traffic related, service related, use related.
- *Identification of experience related emotions:*
  a) Negative: to endure rush-hour-stress, to suffer from fatigue, pressure, impatience, danger, annoyance by noise, pollution,
  b) Positive: alive, vibrant, motion, colorful, sound, people music, engaging people, window-shopping, meetings, exchange…

  This category drew the attention towards contextual and perceptual differences (efficiency for motor vehicles vs. safety and conviviality for pedestrians). A hierarchical representation of categories and sub-categories helped organize and visualize relationships among them, thus inferring new concepts [17].

5.2.3 User Scenario

A user scenario is an important tool in a design process which helps visualize and better understand a user's interaction with the physical and cultural environment. By looking critically at a specific problem a designer learns to better understand the actual needs. A user scenario is usually generated once all information, gathered from qualitative and quantitative research (observations, interviews, opinion polls, focus groups…) have been analyzed. For the purpose of this exercise however, students would only be required to rely on previous observations and personal experience.

The categorization exercise served as an initial tool that helped to identify different users and pinpoint some of the possible needs or expectations in terms of infrastructure, safety measures and accessibility to services.

5.2.4 Qualifying attributes

This part of the creative exercise consisted in emphasizing the perceptual and cognitive aspects of a design project and involved the listing of functions and qualifying attributes. The use of 'manipulative verbs' [18], such as, for example, modify, magnify, minify, or substitute, allowed for extending the search. For example, the notion of safety for pedestrians triggered the following ideas: separation, isolation, segregation enclosure, hierarchization as well as tunnels, barriers, bridges, etc. Some of these terms instantly suggested concepts (Fig. 4).

There are numerous other techniques for creative exploration, such as the use of free associations or the technique of 'forced morphology' [19], consisting of listing features and qualifying attributes in semantic categories and randomly associating some of these attributes, making unique feature configurations possible. However, if applied arbitrarily or mechanically, it may lead to irrational propositions. A critical evaluation and validation of ideas are therefore essential in a design development process.

5.3 Embodiment and Communication of Ideas

Design is a process of creating meaning and of embodiment of ideas using multiple modes of communication. To convey meaning, design uses a design language, which, similar to linguistics, is composed of signs and symbols that carry meaning through its physical representation. Design uses multiple modes to communicate and to embody meaning, either material or immaterial, two-, or three-dimensional. Quoting Kazmierczak [20]:

> 'In design literature, content is interchangeably referred to as *information*, *data*, *message*, *subject*, and *meaning*. The differences in names are the result of differences between terminologies specific to the domains from which these terms were borrowed. Although the names might differ, the approach to them remains the same… The designer's role is to provide the form needed to make a predefined content/ information/ data/ meaning, and message… perceptually accessible in other words, to translate from one form to another.' [20, p.46].

By studying the cognitive processes, the users' perception and interaction with the environment, by identifying noticeable behavioral patterns and by understanding the multi-sensorial nature of a user experience, design is able to propose meaningful interfaces and environments capable of inferring significance to the user [21].

Considering the limited scope of our workshop, a complete analysis of each specific situation would have been too ambitious. Consequently, this exercise started with a brief introduction to communicative and cognitive processes and the perception of semantic qualities [22], enough to draw attention towards perceptual phenomena and to encourage students to reflect on how and in what form they should express meaning and assess the semiotic potential of their concepts as well as the chosen mode of representation [23].

The focal point of the third and final part of the ID experience module was the process of discrimination of ideas and embodiment of coherent design concepts. It involved evaluating the initial ideas, comparing them with the pre-established design objectives, selecting the most promising ideas susceptible to solve the identified problems and develop them into coherent proposals. Then, the task was to visually 'articulate' the refined design intent in a meaningful way [23].

Due to time constraints, the subsequent phases, such as concept refinement, concept validation, design development and design implementation, which would usually complete a design process, were excluded, in favor of creativity and exploration of new methods and tools. Students had to choose appropriate communication tools (sketches, schematic views, reduced scale mock-ups…) to express the main thoughts and values of their concepts. The following section will present some of the concepts generated while following the recommended process.

Fig. 4 shows a concept generated for the subtopic '*to circulate'*. The team, consisting of an urban planer and an architect, analyzed challenges that visually impaired people face on an everyday basis. Inspired by the analytical and creative exercises, students defined design criteria, specified needs, and generated ideas. By suggesting a separate infrastructure for pedestrians (upper level), they were able to address simultaneously the safety issues and propose a new conviviality through walkways with boutique entrances, plaza, café, etc… The lower level was dedicated

to moving traffic, public transportation and provided access to parking and commercial distribution. Strategically located elevators connecting all levels were offering access to underground parking and subways.

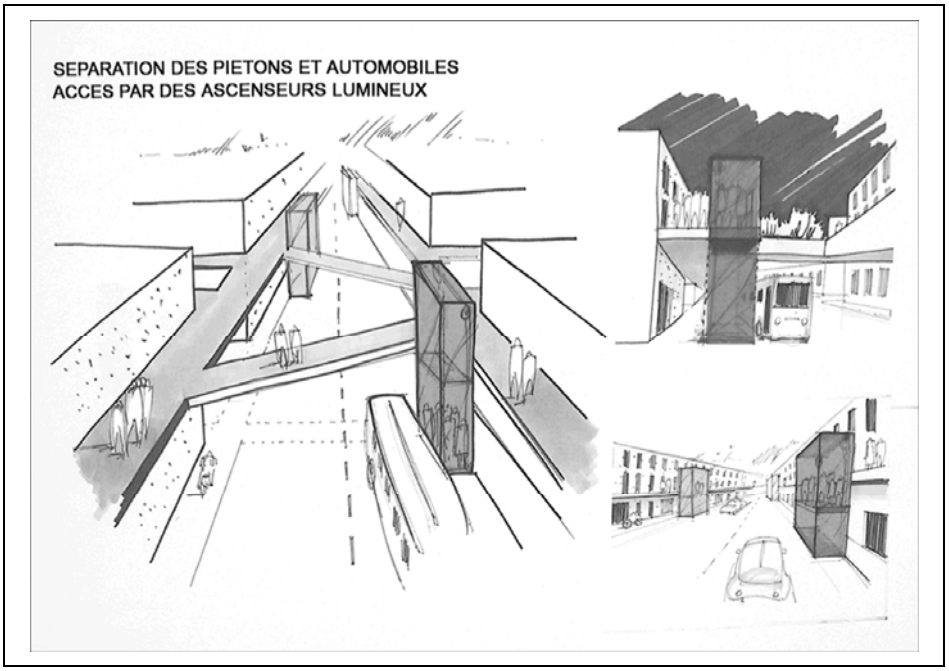

Fig. 4. *Hierarchy, safer circulation in urban environment separating pedestrians from moving traffic (image taken from student project 2006, by É. Albouy, D. Rivard, submitted to T. Leblanc, AME 3030)*

This concept is attempting to address a problem of divergent but coexisting needs by infiltrating territories of other domains, which students - this can be safely assumed - with a purely disciplinary approach would not have attempted.

As depicted in Fig. 5, an industrial design student and an architecture student tried to solve a problem of providing natural and artificial lighting without just creating another lighting fixture, but by improving systems already in place.

Inspired by the overall theme *Nature and Artifice*, and by adopting the suggested methodology, both students detached themselves from the object and instead focused on the function of illuminating. After analyzing the topic of natural and artificial lighting, the student team came to the conclusion that windows should not only assume the role of providing natural but also artificial lighting, especially considering the fact that users at night tend to veil their windows in order to gain privacy.

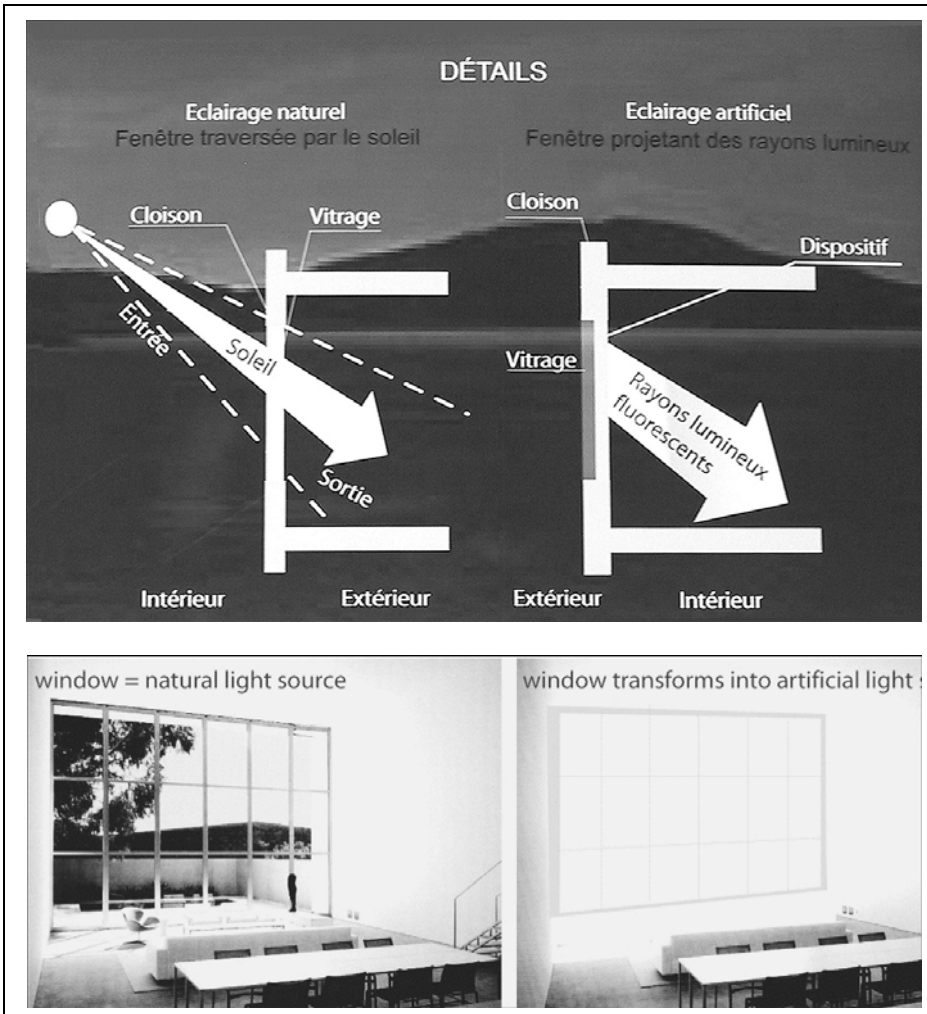

Fig. 5. *Window as a source of natural and artificial light, using photo sensors and fluorescent technologies (image taken from student project by G. Pierre and A. Khansaa, submitted to T. Leblanc, AME 3030,2006)*

The second concept proposed by the same team looked at alternatives for a traditional window structure (Fig. 6). The effects of light and shadow in nature inspired students to attempt recreating similar effects within the interior environment. During the day, the interior is animated by the play of natural lighting and shadows, while at night the building exterior appears animated by the interior artificial lighting exiting the walls.

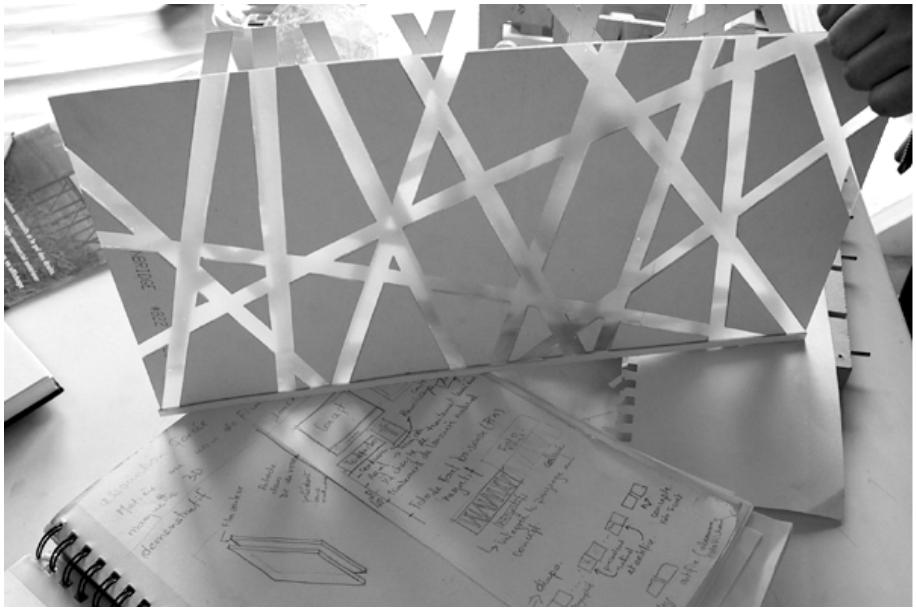

Fig. 6. *Wall unit, window alternative (image taken from student project by A. Khansaa and G. Pierre, submitted to T. Leblanc, AME 3030, 2006)*

6 Transdisciplinarity and Design Research

Integrative approaches in the field of computer science have long been recognized as crucial, especially when designing and developing highly innovative products. Many user interfaces are too complex which represents a major challenge for certain users. Therefore, context-sensitive and user-centered design approaches are imperative in the design of digital products and services and should favor simple and intuitive solutions that are meaningful to a potential user. More and more researchers integrate design because of its cross-disciplinary nature and its ability to provide such user-oriented perspectives.

The School of Industrial Design at the University of Montreal increasingly facilitates interdisciplinary projects with other universities, which allow design students to apply the described methods. One of these interdisciplinary activities involves the School of Industrial Design and DOMUS, a research group at the University of Sherbrooke, uniting students and researchers from several disciplines: computer science, psychology, health science, ethics and design. The goal of this project is to develop intelligent living environments capable of assisting people with cognitive disabilities. This topic is of utmost importance for the Canadian public health sector that is facing numerous challenges due to its aging population, a shortage of resources and a spike in healthcare costs.

Many designers and researchers are trying to tackle such socioeconomic problems. Not only are they directing their efforts towards the prevention of a diminishing quality of care, but they also attempt to address patients' psychosocial needs, with the goal of increasing their autonomy and independence. Modern technologies and intelligent living environments are being widely considered a promising alternative.

Indeed, our information culture is a social phenomenon that has remarkably impacted social habits, engaging the younger generation but unfortunately leaving a great part of our aging population behind. In fact, those who would benefit most from being connected are our most vulnerable population, people with disabilities such as dementia, who are unable to perform simple everyday tasks due to partial memory loss, and are driven to isolation, insecurity and loss of autonomy.

The design research was looking at how technologically driven products and environments affect people's perception, interaction and experience in order to create new user interfaces that are simple to understand and easy to use.

Two subprojects [24] have been focusing on the embodiment of technology and the generation of tangible and intuitive user interfaces, specifically designed for people with dementia. One was addressing the need of assisting the user in localizing objects, and the other was looking at how to assist a user in completing a complex task.

By joining DOMUS in this interdisciplinary endeavor, design students and researchers were merging knowledgebase, learning from each other and generated new creative concepts for tangible user interfaces. The project results have been presented at the 75th congress of Acfas 2007 (Association francophone pour le savoir) in Trois-Rivières, Canada. [25]

7 Conclusion

Interdisciplinary approaches have become common practice in the last years, bringing together experts from various domains, e.g. design, engineering, marketing. Such practices have proven themselves necessary, and well-known corporate structures and design consultancies worldwide recognized the benefit of combining multiple expertise. However, what many interdisciplinary teams struggle with are the boundaries of disciplinarity, which obstruct the effectiveness of an interdisciplinary approach. It is the role of academic institutions to better prepare students for such integrative practices.

This paper intended to stress the importance of teaching transdisciplinary approaches to creative problem solving by describing a teaching model that evolved from a multidisciplinary to a transdisciplinary focus.

Judging from the outcome of the workshop and students' commentaries, one can conclude that exposing students to different cultures, new approaches and divergent perspectives, are key concerns to the success of integrative practices.

As previously explained, transdisciplinary thinking can only be the result of an individual cognitive process. Therefore, only students who were able to assimilate this process felt inspired and enriched by this workshop experience. Few of those,

who were not able to break away from traditional thinking, produced rather predictable results. Most of the students, nevertheless, commented positively on the workshop experience acknowledging that the exposure to multiple design approaches made them realize that there are different ways of looking at a problem. Students also pointed out their increased respect for the other disciplines and more remarkably, some were emphasizing the confidence they gained in their newly acquired creative problem- solving skills.

The paper also made the point that the approach as described in the industrial design experience module is not a method reserved to industrial design, but a process of divergent thinking and observing, placing the human being, his experience, and his interaction with the environment of use in the center of his concern. This paper has shown that the subject matter can vary greatly. Nonetheless, in any case, whether designing a building, a lamp, a website or a software product, it means designing for a user and a socioeconomic context. To gain deeper understanding of the phenomenon surrounding a specific problem, one has to search for answers in various fields, engage in interdisciplinary activities and seek the input and expertise of other disciplines. Therefore it is necessary to point out that transdisciplinary thinking and creative problem solving is not reserved to a discipline in particular. Learning to think in broader terms, seeking to understand complex phenomenon for the purpose of envisioning and defining the future should be everybody's ambition.

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