EDUCATION, DESIGN and PRACTICE

Understanding Skills in a Complex World

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Education, Design and Practice – Understanding Skills in a Complex World

ARCHITECTURE_MEDIA_POLITICS_SOCIETY
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INTRODUCTION

Volume 1

This publication is the product of the conference *Education, Design and Practice–Understanding Skills in a Complex World* held at Stevens Institute of Technology in 2019. The keynote speaker was Peggy Deamer, Yale University. The call upon which the conference and this publication are based argues that:

The relationship between education and practice in any discipline is complex. In an ever changing world, it is also in flux. In a context such as the built environment, it is also interdisciplinary. Today, educators in the liberal arts still identify learning as an end unto itself, and designers still draw on ideas about intuitive knowledge. By contrast, the businesses behind urban development or city and regional growth call for graduates armed with the skills required in practice from day one. At the same time local government and cultural or city management firms need creative thinkers capable of continual adaptation. In the industries and sectors such as construction, transport and engineering, managers focus on a foundational baseline and value engineers and designers as both pragmatic problem solvers and visionaries.

These alternative perspectives have been reflected in multiple changes to the practice and structure of the education sector. One such example was the Boyer - Mitgang report which restructured architectural education in the US to reflect other professions. As in other areas, it resulted in a 'degree arms race', with MAs and doctoral programs multiplying more rapidly than the research and teaching methods they required. At the same time, the 'widening participation' agenda produced an explosion of research and funding for new pedagogical approaches and initiatives. Attempts to fuse education with the creative arts, industry and business through university led partnership schemes also proliferated. More recently, changes in the financing of the HE sector in places like the UK, mean universities now stress educational efficiency and guarantees of graduate jobs.

Working within this context, educators in sectors connected with the design, management and construction of the built environment have developed new and innovative ways to teach, they have embedded collaborative practices

into their pedagogy, have forged unique partnerships across disciplines and outside the academy, and much more. However, research into best practice learning and teaching in the classroom is still evolving and educational initiatives can sometimes be seen as contradicting on-the-job realities in practice. The *Education, Design and Practice conference* publication explores this complex and contradictory scenario from multiple perspectives.

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EXPLORING STUDENTS' COGNITIVE MAPS IN DIFFERENT BUILT ENVIRONMENTS OF ELEMENTARY SCHOOLS

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INTRODUCTION

It could be claimed that children have a wealth of knowledge and experience regarding their school's buildings and open spaces, as they regularly spend a considerable amount of time interacting with their classmates in classes, playgrounds, libraries, and drama stage[1]. At a young age, children are susceptible to the spatial environment of their school, which may have a significant effect on their minds and perceptions, feelings, and attitudes towards school and education[2]. Therefore, building better spatial environments that interact positively with young students could potentially lead to better-quality educational experiences[3]. In this regard, an attractive design can help young students to create a sensory link with the school and its different areas, which therefore will increase students' interest in studying and other related activities and make them prepared for learning and development across physical, cognitive, emotional, moral and spiritual aspects[4].

The area of promoting an effective educational environment has attracted many scholars. However, they used to refer to the educational environment in abstract, behavioral, psychological, or connotative terms while neglecting the implications of the built environment of the school design. Factors such as building age, size, and condition, quality of maintenance, temperature, air quality, natural lighting, noise, and color can affect students' health, safety, sense of self, and psychological state. The built environment that considers these essential factors has the potential to make the school a more likable place for children and promote the time quality they spend there[5].

The current study's main objective is to assess the students' experiences in two different built environments of the elementary school to find how embedding open spaces in the built environment in the elementary school can affect students' perception of their school. The aim is to investigate the connection between healthy mindsets and open spaces through a cognitive approach. Investigating this connection could potentially help to determine what practical changes could be made to school design to improve mental wellbeing. Two case studies of elementary schools from Jeddah city, KSA are investigated. The two schools are significantly different in terms of the spatial environment. The cognitive mapping of students as users of education spaces are used to explore the students' perceptual patterns set in the relationship between the spatial elements and cognitive maps.

LITERATURE REVIEW

It is essential to consider the school as a place for education, where students live and do various activities and not only as a place where knowledge and skills, defined by the curriculum, are transmitted[6]. Open space is the main constituent at the elementary school structure that facilitates transport between the different buildings and where the students have immense pleasure and entertainment while playing with classmates in the playgrounds and natural play spaces. Open spaces of elementary schools are categorized as private open spaces that are usually fenced and designated for children's activities. They can have a significant effect on children's feelings towards education and play a significant role in learning processes. They can be seen as among vital social infrastructure that is required in any school to satisfy students' recreational needs, while the existing plants can act as a buffer zone to prevent sounds, wind, dust, and the sun and provide a pleasant view. Open spaces can give young students a sense of freedom, recreational satisfaction, unity with self, contact with nature, and the spirit of adventure[7]. They enhance students' opportunities for mental refreshment between classes, thereby increasing their performance levels in the class. Besides, they provide a place for physical activity and entertainment that helps in mitigating the negative feelings resulting from the stress of routine studying[8].

There is evidence that open spaces in schools have a significant effect on students' mental perception and emotions that should not be ignored. A recent study found that students in the higher levels of education who visit green open spaces more frequently and spent more time outdoors are more satisfied with the quality of life within the school and more capable of improving their academic performance. The physical setting of open space may also encourage or eliminate opportunities for social engagement among students, fulfilling social relationships, feeling positive and happy, and being prevented from being isolated[9]. Similarly, Schäffer and Thomas Kistemann (2012) highlighted the health and well-being benefits of school gardens and open spaces, and their psychological associations with improved self-control, self-confidence, social skills and communicative capacities of children[10]. Another study approved that accessing to the natural environment has several benefits for students' wellbeing, such as promoting their sense of freedom, moments of joy, and aesthetic pleasure[11].

According to Nasar (1990), the users' experiences about their environment can be assessed, and their assessment is an essential component of the perception process[12]. In this regard, the students can perceive, and assess how quality is their school environment and this awareness correlates not only to the student self-efficacy, but also to their academic performance, absenteeism, and sense of safety[13]. Therefore, it is essential to explore the young students' perception of their schools to support their particular needs, concerns, and spaces needed to support the desired activities and aesthetic preferences.

In the five decades since Kevin Lynch's seminal work "The Image Of The City", researchers have conducted several studies to investigate the effect of the built environment on the users' perception using their cognitive maps. The cognitive map is a memory representation of spatial relationships in people's minds. It is a simplified visual pattern after reducing complex spaces to a simple collection of basic drawn shapes, which often bear little resemblance to the real environment[14]. It is a technique that has been used extensively in research to externalize what lies inside people's minds regarding the experienced environment through the process of drawing. In this process, the users translate their emotional experiences through a series of psychological transformations that they acquire, code, store, and decode information about their environment, such as spaces' elements, relative locations, distances, directions, and overall structure[15]. They represent their memories, emotions, experience in the form of lines that reflect their thoughts about the experienced environment. For example, straight

lines and shapes may indicate that one is stable in the place, while wavy lines reflect calmness, and rough ones give a sense of anger and confusion[16]. In parallel, drawing is a prevalent activity in early childhood that most children like to draw while playing. It is a means of expression that has communicative potentials and one of the languages children use to "talk" to others or even to themselves about the way they perceive the world around them. By drawing, children can represent objects, movements, actions, changes, sounds, emotions, ideas, stories, as well as the difficulties they faced[17].

Studying the collective cognitive maps and investigating the commonalities of children could potentially help designers to assess the built environments of schools and figure out which places are more likely to evoke clear images and be remembered than others. Some reasons for having stronger images are the environment's spatial characteristics, such as visibility, distinctiveness, and regularity, in addition to social patterns of users' daily activities. Having a clear cognitive image of the place helps its users in navigation choice, way-finding behavior, and route learning[18].

Some scholars are concerned with the subject of students' experience in their schools, and the impact of the built environment on the stimulation of positive feelings like happiness, satisfaction and well-being, and an overall enhancement of the educational experience. For example, research that used the cognitive map technique has been conducted on a sample of 30 students at the Selcuk University Campus in Turkey, showed that the social spaces within the campus area where students are gathering and actively enjoying their lives are the most memorable, meaningful and satisfactory places to the students[19]. Another study was conducted in a female university in KSA to assess the students' level of happiness on a university campus by examining the impact of the open space design and setting on the students' wellbeing. The researchers combined the cognitive map with a questionnaire to investigate students' emotional experience of open spaces on campus and their preferable open spaces. The results showed that students feel, perceive, and remember what evokes their positive or negative emotions. Additionally, the students drew more details in the depictions of the spaces that evoke positive feelings while giving less attention to space's details when they drew the areas they disliked[20].

Children are susceptible to the surrounding environment that significantly affects their perception of the world at their young age[21]. As far as we know, there is not enough recent research on the use of young students' cognitive maps in early academic years to explore how they are affected by the built environment in their schools. Therefore, this study's main objective is to assess the students' experiences in two different built environments of elementary schools to find how the embedding or absence of open spaces in the school affects students' perception of their school.

METHODOLOGY

This study has a mixed method that combines both qualitative and quantitative methods. Two governmental elementary schools from Jeddah city, KSA are selected for the purpose of this study. The elementary stage is selected for this study as the early stage of education would potentially impact the students' personality and their attitude towards learning in further stages. Additionally, it represents the stage of detachment from home and family to the real-life experience. The two schools are located in the same district serving only young female students, and they are significantly different in terms of the built environment. The first school named "Sixteen School" has open spaces integrated equally with school buildings and facilities. The second school, "Ninety-Sixth School" is constructed in only one building containing several internal spaces for classes and other facilities. See Figure 1 and 2, and Map 1 and 2

Figure 1 and Figure 2. The first school named "Sixteen School" (left), and The second school "Ninety-Sixth School" (right)
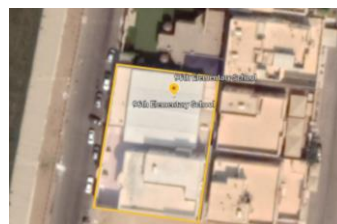
Map 1 and Map 2. The first school named "Sixteen School" (left), and The second school "Ninety-Sixth School" (right)

The cognitive mapping of young students is used to explore how they are affected by the built environment in each school and how the absence or existence of open spaces in the school affects the students' cognitive images of their school. The young female students were asked to draw the cognitive map of their school, showing how they access from the main gate to reach their classes.

Purposive sampling has been used and limited to students from Grade 4, ages 9 -10, who had spent at least two years on the school. Such students have recent experience and heightened awareness of the school environment compared to other grade groups. The time they had spent on the school and their age would have allowed them to develop their perception towards their school and would aid them in restoring their cognitive image about the school. The sampling is limited to female students for cultural restrictions.

For data analysis, the students' cognitive map drawings for each group have been analyzed and compared to find out the principal differences between the two groups' drawings. The symbols, shapes, and nicknames that students used on their cognitive maps are analyzed to see how students represented their own experiences in their schools. The researchers used the content analysis method to analyze, categorize, and organize both visual and verbal materials through students' cognitive maps to find thematic patterns. A peer review with a psychologist was conducted to validate the results.

DATA ANALYSIS

The comparison has been conducted between the two groups of students' maps in each school. The students' cognitive maps have been analyzed to determine which spaces have been perceived and are memorable and how students represent their cognitive images in each group.

To transform the qualitative data that is extracted from each cognitive map, see examples of cognitive maps in Figure 3 and Figure 4. The spaces have been surveyed in each school, and a coding method has been used to refer to the drawn spaces, as shown in Table 1, and Table 2:

- The mentioned spaces: the digit (01) used to refer to the mentioned space in the cognitive map of students, while the digit (0) refers to the non-mentioned space.
- The location accuracy: the digit (01) used to refer to the accurate allocation for each space in the

cognitive map of students, while the digit (0) refers to the wrong allocation.

- Space Scale: the digit (02) refers to the oversized scale of space compared to the whole school area, while the digit (01) refers to the undersized scale.
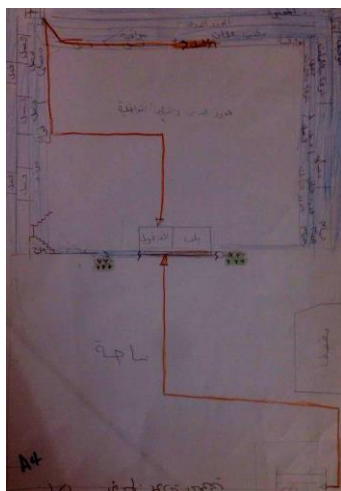
Figure 3 and Figure 4. Example of one of "Sixteen School" student's cognitive map (left), and Example of one of "Ninety-Six School" student's cognitive map (right).

Spaces	Mentioning	Allocation	Scale
	Exist (1)-Not Exist (0)	Same (1)-Change (0)	Large (2)-Small (1)
Guardroom	1	0	2
Main entrance	1	1	2
Schoolyard	1	1	2
Stage	0	1	0
Manager office	1	1	2
Administration offices	1	1	2
Advisor office	0	1	0
Classes	1	1	2
WC	0	0	0
Prayer room	0	0	0
Canteen	0	0	0
Staircase	1	1	1
Elevator	0	0	0
Green elements	1	1	2
Emergency staircase	0	0	0
Total of one student	8	9	15
Total of all students	64	123	121

Table 1. Example of Sixteen School coding system for only one student.

Spaces	Mentioning	Allocation	Scale
	Exist (1)-Not Exist (0)	Same (1)-Change (0)	Large (2)-Small (1)
Guardroom	0	0	0
Main entrance	1	1	2
Schoolyard	1	1	2
Stage	0	0	0
Manager office	1	0	2
Administration offices	0	0	0
Advisor office	0	0	0
Classes	1	0	2
WC	0	0	0
Prayer room	1	0	2
Canteen	1	0	2
Staircase	1	0	1
Elevator	0	0	0
Green elements	0	0	0
Emergency staircase	0	0	0
Total of one student	7	2	13
Total of all students	57	98	107

Table 2. Example of the Ninety-Six School coding system for only one student.

As shown in tables 1 and 2, the first school named "Sixteen School" got a significant rate in the mentioned spaces, accurate allocation and spaces' scale (64, 123, and 121) compared to the second school that got (57, 98, and 107) respectively. The data analysis indicates that the built environment's structure of the first school "Sixteen" is more apparent in the students' cognitive maps than the other school that has no outdoor spaces. Additionally, students in the first school tended to use colorful and steady lines to draw the different parts of their school, unlike the students in the second school who used black and jagged lines.

RESULTS

The results of using cognitive mapping technique helped in assessing the students' experiences of their schools, which are discussed in the following section.

According to tables 1 and 2, the students in the first School where open spaces are integrated with other school spaces showed better perception of the different school areas, in which most of students' drawings involved the green area, the schoolyard, the canteen, the manager room, the administration, and the student advisor room. On the other hand, the students in the second school did not refer to any green areas in their drawings; instead, their drawings focused on classrooms and services.

In general, the students memorized and restored the spaces that they felt enjoyed and entertained such as the canteen, the schoolyard, and the green open spaces. They also tended to draw places that more likable to be bigger than other areas, even if they are not in real life. They drew the neglected zones smaller than reality and with hesitant lines that they feel less interest.

The first school's students were accurate in allocating the different areas and zones in their cognitive maps. They also showed a more conscious perception of the spaces' size and proportion than the other school's students. The drawn lines were bold and straight, and shapes were regular in the first

school's drawings while most lines and shapes of the drawings in the second school were jagged, thin and irregular. The schoolyard has been drawn relatively larger in the first school maps opposite to the second school, which had less representation of outdoor spaces and less accuracy with spaces' allocation. Moreover, they showed more confidence when they memorized, coded, restored, and drew their images that were constructed clearly in their minds. The students in the other school showed less confidence in restoring cognitive images and school details. The previous analysis may potentially indicate that students in the first school were more certain that they made their lines clearer in the cognitive maps.

The students in the first school had a clear image of the circulation structure and hierarchy; most of the students represent the circulation inside the school with straight connected lines while the second school's students drew unclear circulation, represented by irregular zigzag and non-connected lines. In terms of zoning, most of the first school's students' maps showed a similar distribution of zonings to reality in their drawings, while the second school's students mostly drew irrelevant school's zoning to reality.

CONCLUSION

The presence or disappearance of open spaces has shown a clear difference in the students' understanding of the spatial structures in the two schools and the students' mental images. In the present study, the spatial structure of the built environment of the first school that is based on the integration of the open spaces and buildings evoked clear cognitive images of young students and made it easier for them to perceive the place components and spatial relationship. On the other hand, the cognitive maps of second school students showed the feeling of dissatisfaction with the school environment. Through what is found in their drawings of excitement, stress, and fatigue. In this regard, the cognitive map analysis has proved its validity as a useful tool that helps probe into depth what lays inside students' minds towards the school environment. Finally, it is recommended to consider the proper integration of green open spaces in the elementary schools to promote the positive emotions of the student towards school environment and enrich their experiences in their first educational stages.

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ARCHITECTURAL DESIGN MODEL AND PRIORITIZATION OF DESIGN PRINCIPLES FOR HIGH SCHOOLS BASED ON AN EDUCATIONAL PROGRAM (SCOPE OF STUDY: IRANIAN HIGH SCHOOLS)

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INTRODUCTION

Besides further understanding of the built environment impacts on human,[1] many studies in the second half of the 20th century have proved that the physical situations and psychological factors have absolute impacts on students learning as well.[2,3,4] Meanwhile learning psychology and educational methods have changed[5] and the teacher-centred and passive methods are replaced by student-centred methods, problem solving and improving the team working among students and introducing them to the real world. [6]

Since studies show that the traditional school design is no more capable of implementing new goals and missions in education[7], architects have also challenged the traditional viewpoints about educational spaces design and many studies in the field of principles for educational spaces design are done recently with different approaches.[8] Although these principles have changed the global vision about school design, few of them are proposed regarding an educational program, or trying to prioritize these principles based on a specific context. So, it is not easy for the architects to select the appropriate or the most important principles for their design among all these guidelines, because the educational program in each context is not regarded as a basis. "In other words, the design principles are not localized enough to be useful for the designers and planners to provide an appropriate criterion for decision making" [9].

Regarding the model for high school design proposed by Hosseini , in this article the different aspects of this model and its subgroups are discussed. Each aspect and subgroup contain architectural principles for high school design and the importance of these principles is evaluated by a closed questionnaire based on the Iranian Educational Program (IEP). The questionnaires were filled by the architects employed in the "National Organization of Development and Renovation of Schools" in Iran.

DATA COLLECTION AND METHODOLOGY

The main objective of this article is to prioritize the different aspects of the design model for high school based on the goals and missions of IEP. Also, this study tries to find out the most important

design principles based on the viewpoints of the architects engaged in this field. This will show us that the concerns about high school design in Iran are aligned with which approaches and viewpoints, and which principles should be emphasized in the future design of Iranian high schools.

Iranian Education Program (IEP)

In order to find out which design principles are the most important for Iranian high schools, the goals and missions of this program have been studied. As the figure (1) shows, this program has four main goals which are:

1- Transmission of Iranian culture : "safeguard cultural heritage, cultural values, and accumulation of knowledge, and transfer these to new generations by enriching this heritage"[10].

2- Socialization : "the lifelong process of inheriting and disseminating norms, customs, values and ideologies, providing an individual with the skills and habits necessary for participating within their own society. Socialization is thus the means by which social and cultural continuity are attained".[11]

3- Personal development and foster individual talents: learning life skills such as lifelong learning, critical thinking and problem solving skills, physical and mental health and using the new technologies for learning [12].

4- Providing human resources for the society: developing professional skills for jobs as well as knowledge about economy and job market[13] .
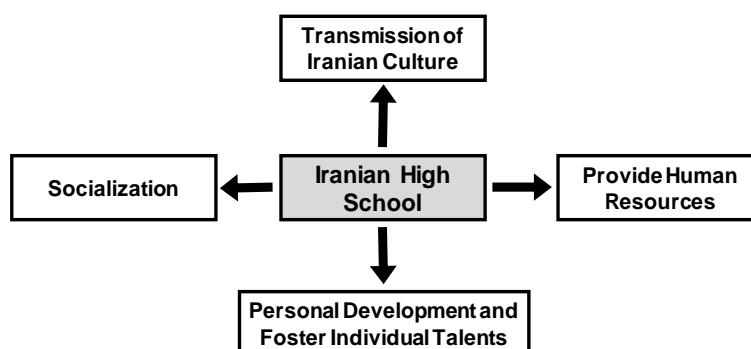
Figure 1. The goals and missions of IEP for High Schools [14]

Based on the goals and missions of IEP, we can find out which design principles should be given the priority during the programming and design phase.

Architectural principles

Based on the design model for Iranian high schools proposed by Hosseini (figure 2)[15], 76 principles are classified under six main aspects as formal, functional, socio-cultural, psychological, technological and ecological aspects. Tables (1) to (6) show these principles. The number of each principle is the number on the questionnaire.[16]

Figure 2. Comprehensive model for high school design in Iran based on IEP [17]

Sense of Place	Q27	Design well defined and welcoming entries[18]
	Q26	Consider the effects of colors on students, choose colors which can remain in the places for a long time[19]
	Q12	Design learning environment as a three-dimensional textbook[20]
	Q3	Design smaller schools "plan schools as neighborhood-scaled community learning centers" [21] .
	Q18	Design well-defined spaces[22]
	Q25	Colors and finishing materials should enhance the aesthetic qualifications[23]
	Q17	Design dynamic schools[24]
	Q16	Pay close attention to the design of the recreational spaces and leisure facilities[25] to make students spend more time at school[26]
	Q9	Provide every teacher with a personalisable area and places to collaborate[27]
Space Diversity	Q7	Provide ""student commons" as gathering points for socializing and/or instructional use"[28]
	Q14	"Create weather-protected transition spaces between inside and outside"[29] as learning spaces, gathering points and for socialization[30]
	Q6	"Design for a variety of learning groups and spaces" [31] .
	Q15	Design multipurpose spaces[32]
	Q11	Design outdoor learning spaces[33]
	Q10	"Provide space for sharing instructional resources"[34]
	Q1	School design should be flexible, adaptable and deployable [35] .
	Q8	"Provide ample areas for the display of student work"[36]
cal Comf	Q4	Design defensible spaces[37]
	Q13	Provide visual and physical connection to the outdoor areas[38]

	Q5	"Design healthy buildings" [39]
	Q22	Consider aesthetic durability[40]
	Q2	School facilities should be useful for all students (universal design), including the students with disabilities [41] .
Aesthetics	Q21	Consider style, scale and symbolism[42]
	Q23	The design style should not look dated[43]
	Q24	Design stimulating architecture[44]
	Q19	"Separate active noisy areas in the school from quiet study areas"[45]
	Q20	Consider aesthetic principles in design[46]

Table 1. Formal Principles

	F7	Design facilities and spaces to meet the new requirements and needs of high schools[47]
Developmental Requirements	F3	School design should be capable of using new methods of teaching and learning[48]
	F9	Design sustainable physical fitness for practice regularly[49]
	F2	Different places in school should be grouped and located[50]
Educational Requirements	F6	Design schools to support variety of teaching and learning methods[51]
	F8	Consider the maintenance aspects in design[52]
	F4	Design schools regarding the fact that the students will spend more times in schools[53]
Users' Requirements	F5	Design flexible learning environments to support team working and alternative activities[54]
	F1	Consider the users' needs[55]
	F10	Provide spaces for job training[56]
	F11	Design school and facilities in a way that they can be easily used[57]

Table 2. Functional principles

Community Involvement	S2	Schools should be "easily accessible by walking, car or mass transit"[58]
	S4	"Respect contextual compatibility while providing design diversity"[59] to make schools "serve as a visible symbol of community pride" and create the sense of belonging among students[60].
	S3	Increase parents and community involvement[61]
	S1	Design schools that allow the community use of school buildings and facilities[62]
Community Use	S7	Provide spaces for visitors and parents who visit the school[63]
	S6	"Create outdoor amphitheaters serving student and community events"[64]
	S8	Design school facilities to be open to different community groups 24 hours a day/ 7 days a week[65]
	S5	Provide spaces as an interface between school and community/parents to increase parents/community involvement

Table 3. Socio-Cultural principles

Interior Design	P12	Use the natural light in the interior spaces to improve the students' performance and reduce their fatigue[66].
	P7	Use green plants, lighting and colors in interior spaces to create good feelings[67]
	P11	Provide "physical comfort and well-being" in school design[68]
	P3	Design places with appropriate scale provide more intimate spaces and create comfort for all[69]
	P10	"Allow learners to personalize their space as much as possible"[70] to provide them with the sense of identity and self-respect[71]
Exterior Design	P8	Design high school in which students and teachers feel proud[72]
	P1	High schools design should serve as symbols of their communities[73]
	P4	School design should be warm, funny, open and attractive and shows the function of the school[74]
	P9	Design the exterior and interior facilities with appropriate scales so the students can use them independently[75]
	P5	Design schools as welcoming places[76]
Context Design	P2	Design small learning communities to improve student engagement and a sense of belonging[77]
	P6	Consider home as a template for school[78]

Table 4. Psychological principles

Technology	T1	The school design should provide the necessary infrastructure for ICT, also the design should provide the infrastructure for the requirements of using the technology in future.[79]
	T2	Integrate school design and technology[80]
	T3	Provide requirements for distance learning[81]
	T4	Provide the necessary infrastructures for educational programs in schools via educational software and internet[82]
	T5	Increase the access to the internet all around the school[83]
	T6	Provide the potential for using personal computer for every learner[84]
	T7	Provide the appropriate physical, acoustic and visual situation for using new technologies[85]

Table 5. Technological principles

Material and Energy	E4	Use recycled construction materials and minimizes the waste during construction and performance of the high school[86]
	E1	Design for using the most from the renewable energies[87] .
	E7	Reduce the environmental pollution[88]
	E2	Reduce the use of nonrenewable resources[89] .
	E6	Reduce the usage of water and non-renewable natural resources[90]
	E3	Use the durable, environment-friendly and non-toxic materials[91] .
	E5	School design should reduce "adverse impacts on the local environment and serves as an amenity for the surrounding community"[92].
	E8	Consider the site situation (topography and ….), adapt the building to the site[93]
Environmental Interactions	E11	Provide aquariums, terrariums, and living plants to the learning spaces[94]
	E10	Increase the students' connection to the natural environment[95]
	E9	Consider the local climate in design[96]

Table 6. Ecological principles

Data analysis and results

In order to evaluate the importance of the design principles, a closed questionnaire was prepared based on the Likert scale (0 to 5) and filled by the architects who are employed in "*National Organization of Development and Renovation of Schools*", which is the only organization in Iran that is responsible for the construction and renovation of public schools. The referees were supposed to evaluate the importance of each design principle from 0 to 5 for the existing and desired situations (while 0 means not important and 5 means the most important).

The collected data through questionnaires has been analyzed by SPSS software through Exploratory Factor Analysis (EFA) method. EFA is a statistic technic to find out the main factors and the categories under each factor, "which means that it sorts a set of variables into different aspects of a model (structure of factors)" [97] based on the data of the questionnaires. Also, this method calculates the most important variables among others. As in this research the variables are the design principles, through this method it is possible to discover the most important principles, and the importance of different aspects of the proposed model.

Table (7) shows the results of our data analysis. The value of *total variance* explained for each group, shows the priority of that group among others. The higher variance shows the higher priority. Based on these variances, the priority of each aspect of the model for existing and desired situations are evaluated.

	Formal	Functional	Socio-cultural	Psychological	Technological	Ecological
Total variance explained % (Desired situation)	87.50	75.22	77.32	74.21	70.39	83.05
Total variance explained % (Existing situation)	85.40	69.11	70.95	71.97	74.39	73.88

Table 7. EFA analysis results for desired and existing situations

Table (8) shows the priority of the aspects for existing and desired situations from the most to the least importance based on the value of *total variance explained*.

Existing situation	Desired situation
Formal aspect	Formal aspect
Ecological aspect	Ecological aspect
Technological aspect	Socio-cultural aspect
Psychological aspect	Functional aspect
Socio-cultural aspect	Psychological aspect
Functional aspect	Technological aspect

Table 8. Priority of the aspects in desired and existing situations

In table (9), the subgroups are arranged based on the value of *loadings of variables*. The value of *loading of variables* shows the importance of each design principle. The subgroups are named by Hosseini.[98]

Loadings of variables	Formal Principles	Subgroup	Loadings of variables	Formal Principles	Subgroup	Loadings of variables	Formal Principles	Subgroup
FORMAL PRINCIPLES			**FUNCTIONAL PRINCIPLES**			0.823	P7	Interior design
						0.783	P11	
0.874	Q27	Sense of place	0.878	F7	Developmental requirements	0.748	P3	
0.820	Q26		0.835	F3		0.691	P10	
0.796	Q12		0.803	F9		0.883	P8	Exterior design
0.742	Q3		0.607	F2		0.767	P1	
0.739	Q18					0.648	P4	

Loadings of variables	Formal Principles	Subgroup	Loadings of variables	Formal Principles	Subgroup	Loadings of variables	Formal Principles	Subgroup
0.705	Q25		0.826	F6		0.645	P9	
						0.644	P5	
0.615	Q17		0.777	F8	Educational Requirements			
						0.908	P2	Context design
0.549	Q16		0.707	F4		0.630	P6	
						TECHNOLOGICAL PRINCIPLES		
0.498	Q9					0.910	T1	
			0.708	F5		0.905	T7	
0.927	Q7		0.702	F1	Users' Requirements	0.895	T6	Technology
0.871	Q14		0.648	F10		0.871	T5	
0.825	Q6		0.631	F11		0.832	T4	
0.824	Q15	Space diversity				0.745	T3	
0.801	Q11					0.662	T2	
0.661	Q10		**SOCIO-CULTURAL PRINCIPLES**			**ECOLOGICAL PRINCIPLES**		
0.660	Q1					0.925	E4	
0.561	Q8		0.909	S2	Community involvement	0.873	E1	
			0.891	S4		0.852	E7	Material and energy
0.881	Q4		0.829	S3		0.820	E2	
0.824	Q13		0.738	S1		0.786	E6	
0.815	Q5	Physical comfort				0.780	E3	
0.689	Q22		0.931	S7	Community use	0.777	E5	
0.570	Q2		0.790	S6		0.608	E8	
			0.715	S8				
0.922	Q21		0.659	S5		0.871	E11	Environmental interactions
0.811	Q23					0.855	E10	
0.810	Q24	Aesthetics	**PSYCHOLOGICAL PRINCIPLES**			0.816	E9	
0.602	Q19							
0.585	Q20		0.871	P12				

Table 9. Priority of design principles based on IEP

DISCUSSION

As table (8) shows, the formal and ecological aspects are the most important aspects in both existing and desired situations. The hierarchy of the spaces and arrangement of different learning zones, as well as the appearance of the building seem to be the most challenging parts that are considered in the school design by the architects and still, they believe that these areas need the most attention for the appropriate high school design. These principles are also close to what is called as *principles for site*

and building organization by Lackney and Tanner [99]. They are mainly related to the whole design of the building, but they become significant in school design because studies prove their absolute effects on students learning and well-being [100]. Since these are basic design principles, this could be a reason that they are regarded as the most important aspect of the design in both existing and desired situation.[101]

The various climate zones all around Iran might be an explanation for the importance of ecological aspect. The Iranian architecture heritage is full of examples of intelligent design solutions for using natural resources for heating and cooling in harsh summers and cold winters. Many of these concepts are still useful to reduce the use of fossil energy resources and improve the usage of natural resources such as building direction, windows orientation, arrangement of open, semi-closed and closed spaces etc. Regarding the global warming and the climate change, many studies in school design emphasize on green building design and reducing the usage of fossil resources.[102] The importance of this aspect demonstrates the same concerns for the Iranian architects.

Emphasizing more on the socio-cultural aspect in desired situation can be the result of the limited use of schools by public in Iran and the potential opportunities that the Iranian architects found to increase the efficiency of these buildings. Another point is that while there are still lack of educational facilities in some areas in Iran, the decline in population growth rate in other areas results in school buildings that are no more used and remain as empty buildings with no function[103], which is a waste of national resources. While considering the appropriate design principles provide opportunities for the society to use these buildings and facilities based on the society requirements. This viewpoint is aligned with many architects who try to provide opportunities for the society in order to optimize the usage of the public investments in school construction.[104]

While many studies believe that ICT might change the whole concept of school design in near future, considering this aspect as the least important factor among others might be a sign that the Iranian architects do not think that technology can have a significant influence on education in Iran, or they might consider it less important because of the lack of adequate facilities and infrastructure for using the new technologies in schools. Although it might take some time to integrate technology in education in Iran, still it is necessary for the architects to be aware of the requirements in order to provide necessary infrastructures to facilitate the integration of technology in schools in near future.

Based on the value of *loadings of variables* which are more than 0.85 in table (9), the most important design principles for high schools in Iran based on the IEP are as table (10).

Q4	Design defensible spaces[105]
Q7	Provide ""student commons" as gathering points for socializing and/or instructional use"[106]
Q14	"Create weather-protected transition spaces between inside and outside"[107] as learning spaces, gathering points and for socialization[108]
Q21	Consider style, scale and symbolism[109]
Q27	Design well defined and welcoming entries[110]
F7	Design facilities and spaces to meet the new requirements and needs of high schools[111]
S2	Schools should be "easily accessible by walking, car or mass transit"[112]
S4	"Respect contextual compatibility while providing design diversity"[113] to make schools "serve as a visible symbol of community pride" and create the sense of belonging among students[114].
S7	Provide spaces for visitors and parents who visit the school[115]
P2	Design small learning communities to improve student engagement and a sense of belonging[116]
P8	Design high school in which students and teachers feel pride[117]

P12	Use the natural light in the interior spaces to improve the students' performance and reduce their fatigue[118] .
T1	The school design should provide the necessary infrastructure for ICT, also the design should provide the infrastructure for the requirements of using the technology in future[119]
T5	Increase the access to the internet all around the school[120]
T6	Provide the potential for using personal computer for every learner[121]
T7	Provide the appropriate physical, acoustic and visual situation for using new technologies[122]
E1	Design for using the most from the renewable energies[123]
E4	Use recycled construction materials and minimizes the waste during construction and performance of the high school[124]
E7	Reduce the environmental pollution[125]
E10	Increase the students' connection to the natural environment[126]
E11	Provide aquariums, terrariums, and living plants to the learning spaces[127]

Table 10. 21 Principles for high school design in Iran

These principles should be the most important concerns for the Iranian architects in programming and design phases.

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_MPATHIC DESIGN: EMPATHIC DESIGN THINKING FOR TODAY'S SOCIAL ISSUES

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INTRODUCTION

Design Thinking, the systematic, rigorous methodologies, and modes of inquiry used by designers, requires new approaches when preparing students for socio-cultural designing in our complex, divisive climate. This paper introduces the *mosaic,* a self – formulated methodology at the core of _mpathic design, a self - formulated initiative, pedagogy, and practice. Created and tested in academic, community, and professional contexts, the *mosaic* inspires and empowers participants, transforming mindsets through an approach of understanding other perspectives while acquiring the skills of empathic design thinking. This article details _mpathic design's (with the "e" removed for "ego") development of two sociocultural design projects for the "father of black history," Dr. Carter G. Woodson. Through both projects, students obtain the empathic design thinking skills required for topics of race, historical narrative, and cultural landscapes for their 21st-century design toolkits.

Empathic Background

Susan Lanzoni, historian of psychology, psychiatry, and neuroscience, defines empathy as "our capacity to grasp and understand the mental and emotional lives of others," a "variably deemed a trained skill, a talent, or an inborn ability."[1] A study of American college students from 1979 to 2010 indicates a sharp drop –off on measures of empathic concern and perspective-taking.[2] This drop notes the importance of obtaining empathic behaviors while in the academy through inclusive curriculums to meets the needs of our complex world. Borrowing from the concept of the "cultural mosaic," coined by John Murray Gibbon, author of Canadian Mosaic: The Making of a Northern Nation, the *mosaic* adopts socio-cultural acceptance of one's characteristics and heritage (a piece in the mosaic), instead of the "melting pot" metaphor in the United States.[3]

As a returning alumnus and new faculty of the University of Virginia's School of Architecture, experiencing the white supremacist events of August 2017, research began into empathic pedagogy. The approach benefits from a design role at the Ontario Science Centre's (OSC) Science Content and Design Department utilizing empathic design for the city of Toronto's population. The *mosaic* incorporates Lanzoni's form definition of empathy *Einfuhlung* – meaning "in – feeling." Lanzoni defines this as the aesthetic activity of transferring one's own feeling into the forms and shapes of objects – where at the OSC expands to connect, educate, inform, and delight an inclusive audience.[4]

Early research focused on empathy skills developed by IDEO, where design thinking "relies on the human ability to be intuitive, to recognize patterns, and to construct ideas that are emotionally meaningful as well as functional."[5] IDEO's use of empathy maps as a brainstorming tool to record what consumers say and do, designers project what users think and feel - to capture "in feeling." _mpathic design and the *mosaic* recognize these aspects as foundational while incorporating political scientist and economist Herbert A. Simon's definition that to design is to "devise *courses of action* aimed at changing existing situations into preferred ones."[6] Hybridically, the *mosaic* introduces empathic *courses of action* to help overcome the *wicked problems* (problems/issues of knowns and unknowns, found in socio-cultural contexts), as noted by Design Theorist Horst Rittel.[7]

The *mosaic* - Connections to Practice

The methodology integrates learnings of a sixteen-year tenure as design coordinator role at the Ontario Science Centre (OSC), Toronto.[8] Continuing links to practice, the *mosaic* sources the 2018 NASEM report *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education – Branches of the Same Tree,* for the 21st-century workplace skills students require (followed by the experiential outcomes*):*[9]

- **Written and oral communication skills** – through meeting with stakeholders, developing empathic interview questions, and presentations of designs.
- **Teamwork skills** – students of various fields work together in collaborative design teams.
- **Ethical decision making** – deep thinking on how to design after the August 2017 events where students create a design mindset.
- **Critical thinking and deeper learning** – at all stages of the experiential designing and making process, individually and collectively.
- **Content mastery** – through research and understanding of stakeholder needs and sociocultural precedent examples.
- **General engagement and enjoyment of learning** – by being a part of change/courses of action/design activism.
- **Empathy** – through a cognitive view, and the other a series of interpersonal (affective) to utilize with stakeholders.
- **Resilience** – by working within Design Teams to learn the process, within a supportive space to discuss design ideas and difficult topics, simulating professional exhibition development teams.
- **The ability to apply knowledge in real-world settings** – by designing in response to the events and aftermath in Charlottesville.

The mosaic

The first stage is Empathic Discovery - an empathic foundation for design thinking for sociocultural design. The second stage is experiential – featuring the "five identifiable stages in the sequence of designing and making" from British author, scholar, and architect Patrick Nuttgens.[10]

- *Identification: discovery or recognition of needs*
- *Collection: of information, assembly of facts*
- *Analysis: of those needs and facts*
- *Idea: the new potential thing that which exists, or will exist, to bring together and make into one the needs, techniques, demands, and means*
- *Realization: things take shape, work or fail. fail, you may go back to further thought and analysis.*

The last stage is empathic implementation – where design teams determine how to implement designs as connective as possible.

Process in Action

Two design projects focused on the life and legacy of Dr. Carter G. Woodson highlight the *mosaic* in action. Dr. Woodson was an educator, author, historian, and founder - known internationally as the "father of black history," the second African American to obtain a PH.D. from Harvard (behind W.E.B. DuBois).[11]   Collaborations with the Buckingham County African American Historical Society, the caretakers of Dr. Woodson's birth site in New Canton, Virginia, resulted in two real-world Design projects:

Project 1 - spring 2018, a Design Thinking seminar (in four design teams) with 14 University students from varied academic backgrounds producing memorial design concepts for Dr. Woodson's birth site in New Canton, Virginia, as shown in Figure 1.[12]

Figure 1, Current Dr. Carter G. Woodson's birth site in New Canton, Virginia. The current site contains an aged information panel, cared for by the Buckingham County African American Historical Society.

Project 2 - In fall 2018, nine Design Thinking students (in three design teams) designed a traveling exhibition entitled "blue // black" (referring to the blue tones of the nearby James River and the Blue Ridge Mountains, and black - Dr. Woodson's work) as shown in Figure 2.[13]
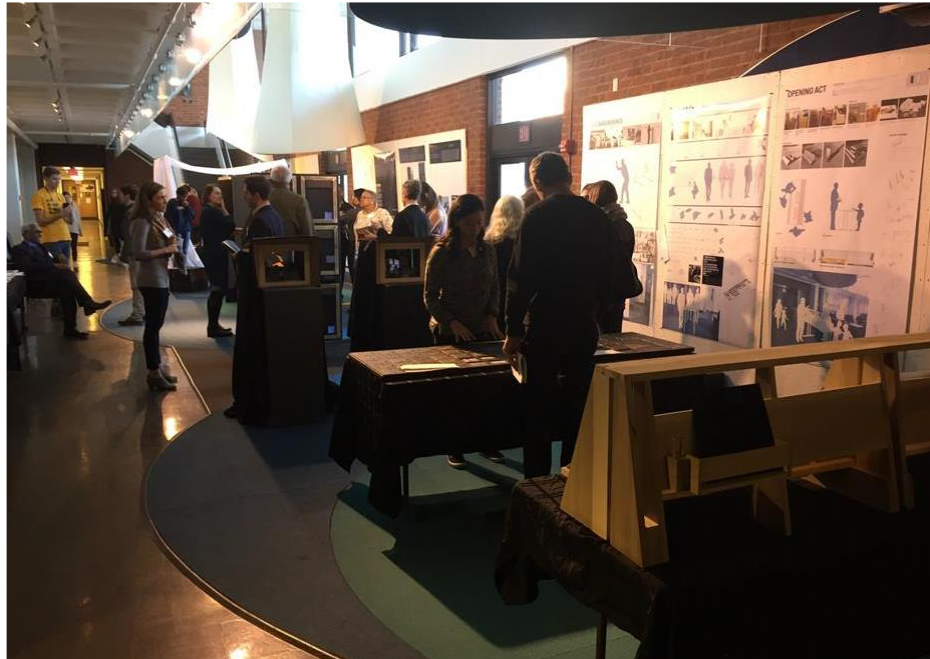
Figure 2. Completed traveling exhibition blue // black, December 2018.

EMPATHIC DISCOVERY

Empathic Introduction

Peter Rowe details that design thinking concerns "the interior situational logic and decision making processes of designer's in action, as well as the theoretical dimensions that both account for and inform this kind of undertaking."[14] Students practice Rowe's framework, through the *mosaic*, beginning with demonstrated empathy from the instructor.[15] The empathic introduction includes:

- Learning details of initial meetings with members of the Buckingham African American Life and History Society and Carter G. Woodson Institute.
- The authors' personal "interior situational logic" from familial accounts of the Orangeburg Massacre of 1968 at South Carolina State University (where South Carolina State Police murdered three students).[16]
- A lecture focused on The Spiral Group - a New York City artist collective of African Americans, ranging in age from 28 to 65, with diverse professional roles such as artist, painter, court clerk, art dealer, floor waxer, and a Ph.D. candidate. First conceived in 1963 to plan the group's March on Washington, members sought to investigate the role of the black artist in a climate of segregation in its two-year existence.[17]

Outcomes

Students participate in course feedback discussions ranging from comparisons of designs for "founding fathers" in the Central Virginia region to the current state of Woodson's birth site. Several students recounted their experiences and trauma during the August events in Charlottesville, many noting the lack of spaces to discuss the events in academic settings. The orientation results in an open, connected, and comfortable space for the work of the semester and personal growth of Rowe's framework.

Empathic Readings

In the second course workshop for the birth site project, students write down their fields of study and "three things most people don't know about you." Students share responses in small groups, then with the full class. Students create diverse teams based on answers. Students begin empathic readings with Dr. Theresa Wiseman's course reading concept analysis of empathy:[18]

- seeing the world as others see it (perspective)
- being non-judgmental
- understanding another's feelings
- communicating the knowledge

Next, students read Dr. Helen Reiss' and Gordon Kraft-Todd's E.M.P.A.T.H.Y. A Tool to Enhance Nonverbal Communication, providing a series of identifiable affective behavioral aspects as an implementation tool: E for Eye contact, M – Muscles of Facial Expression, P – Posture, A – Affect, T – Tone of voice, H – Hearing, and Y – Your response. [19]

Outcomes

Students comprehend the effectiveness of design team collaboration, enacting newly obtained empathy skills to utilize with each other- and on community site visits. Active listening and empathy skills testing occur with one – to – one practice conversations in the course. Alissa Diamond, a Ph.D. student of the course, recounts her empathic mindset at the end of the module:

"We prepared for our next community meeting by digging into the stories that the Society had mentioned at the site. From the starting point of one man's life, we began to see a tightly networked set of histories that transcended social, spatial, and temporal scales. Just from his biography and immediate family history, I saw echoes of all the schoolbook narratives I had learned growing up in Virginia, but from a perspective that had not been given space in my grade school years."[20]

IDENTIFICATION

Empathic Identification Chart

The experiential designing and making process begins in Project 2, the traveling exhibition (in three student design teams titled Ground – Up, Mis-Education, and Unwritten), with an empathic identity chart. The chart is a tool from professional practice (OSC) used to identify potential visitors for the exhibition, as illustrated in Figure 3.

Figure 3. Identity Chart by Design Team UnWritten.

Students list the potential identities as well as individuals who would have slight or no interest in the exhibition, noted across the top of the chart. Students respond to a series of identification questions, and more in-depth empathic thinking inquiry.

Outcomes

The empathic identity chart plays a critical role for teams beginning to assemble ideas as an invaluable resource for questioning. Teams return to the chart to evaluate whether their design development creates the desired visitor experience from multiple perspectives. Furthermore, in future design reviews, students adopt one of these identities for critical analysis of proposed designs.

COLLECTION / RESEARCH

In both projects, students read Woodson's Mis-Education of the Negro, for an empathic lens into of Woodson's design thinking on African American history, and ideas for new forms of educational curriculums.[21] Students begin to research socio-cultural precedents, evaluating the following:

- historical content – how the design captures history while educating the visitor
- empathic design composition – does the design allow for the pragmatic and conceptual definitions of empathy to emerge
- clarity of narrative – does the design tell this new narrative, namely an empathic one that could influence socio-cultural change

Precedents included:

- Dred and Harriet Scott Statue, St. Louis
- Octavio Catto Statue, Philadelphia
- Smithsonian National Museum of African American History and Culture (NMAAHC), Washington, D.C.
- National Memorial for Peace and Justice, Montgomery, Alabama
- James Madison's Montpelier — Mere Distinction of Colour exhibition

Outcomes

The precedent exercise introduces sociocultural design research to students through empathic critical analysis, continuing Rowe's framework. For example, in the birth site project, design team HUMANITY's study begins with the National Memorial for Peace and Justice, expanding to related design precedents.

- Visitors not only experience the form of the memorials but also relate to it, in terms of the scale of the body in the landscape.
- Leading to an understanding of scale at the birth site, forcing visitors to question themselves within the context of Dr. Woodson's life.
- Desires to add water to suggest the flow of time, which would mirror the nearby James River, showcased in additional precedent research.

ANALYSIS / SYNTHESIS

In Project 2, the traveling exhibition blue // black, design teams create a "To, By, So That" established at the OSC to solidify the design team's mission and vision.[22]

> **To**: (the purpose of our Design is to)
> **By**: (using these *courses of action*)
> **So That**: (how the *courses of action* shift the existing to preferred)

An example of from design team "Unwritten":

> **To:** Place yourself in a world of complex identities
> **By:** Reflecting on the life and legacy of Dr. Woodson and black culture's role in shaping American history
> **So That:** We are all more informed and aware of the past and ourselves

Students develop collective design briefs, following examples created by the Science Content and Design department of the OSC in a 3-hour design thinking workshop, as shown in Figure 4.

Figure 4. Example from the Design Brief - Students' descriptions of Introductory and section copy panels.

Outcomes

Students fully experience the collaborative professional process of detailing Visitor Experience into a single document, allowing for student leadership and accountability, a prototype for connecting with stakeholders. The brief is a guide in the design studio for the remainder of the semester.

IDEATION

For the traveling exhibition, blue // black, students experienced the processes of professional design practice ideation from schematic design to fabrication.

Idea Sharing

Students visualize their first three exhibition ideas on 8 ½" x 11" paper during an in-course design workshop, after:

- Viewing of images of a walk-through of the NMAAHC
- Visiting exhibitions at the nearby Rotunda on the Academical Village at UVa for an understanding of the full-scale requirements
- Experiencing the instructor's in-progress exhibition about the Enslaved African Americans at the University for the Rotunda (currently on display)
- Reviewing the earlier precedent exercise from the Collection phase

Small Scale Idea Generation

Students prepare small three exhibition models and drawings at 3" (W) x 3" (L) x 3" (H) to understand the scale of the final presentation space in the School of Architecture.

Outcomes

Students obtain a spatial, scalar understanding of their concepts, referring to the goals of the Brief to match developed narratives. Students hold discussions within teams, sharing in a collective conversation using a series of scenarios relating to the identity chart. Students discuss material options to ensure content messaging before moving up to ½ scale. Wood scale figures "tour" the exhibition, with each student taking one of the developed identities from the empathic identity charts to provide empathic feedback.

REALIZATION

Design Development

Full–scale prototypes of foam core are produced - a methodology from the OSC for testing and prototyping for exhibitions. Reviewers, in the mindset of the Spiral Group, include faculty from Medicine, Nursing, Public Health, Music, a local historian, leaders from the University's Carter G. Woodson Institute, architects, and members of the Society.

Outcomes

Students utilize empathy skills with all guests, resulting in:

- A community member discussing how the entry section taught them more about Woodson's life (over what they knew as a lifetime resident educated at Woodson High School).
- Several guests noted that the "confessional booth" (designed by student Rohan Kohli) allowed them to discuss racial issues in a way they never have before.
- Notation of the darker to lighter tones of the exhibition, leaving feeling uplifted by the positive message at the ending exhibition.

- Society members feeling that the experience would relate to those interested, and not, in Woodson's life.
- The respite area, where visitors could sit on the prized slate (the region's world-famous natural resource), allowed visitors to understand the connection of natural resources and the birth site.

Society members expressed that the exhibition achieved desired goals – stating that they felt the works deeply connected with many entry points. Students refined designs, heading into preparing construction drawings, reviewing with the School's fabrication workshop to ensure constructability. In the remaining six weeks of the course, students fabricate for display at final reviews with the same guests from the midterm review.

IMPLEMENTATION
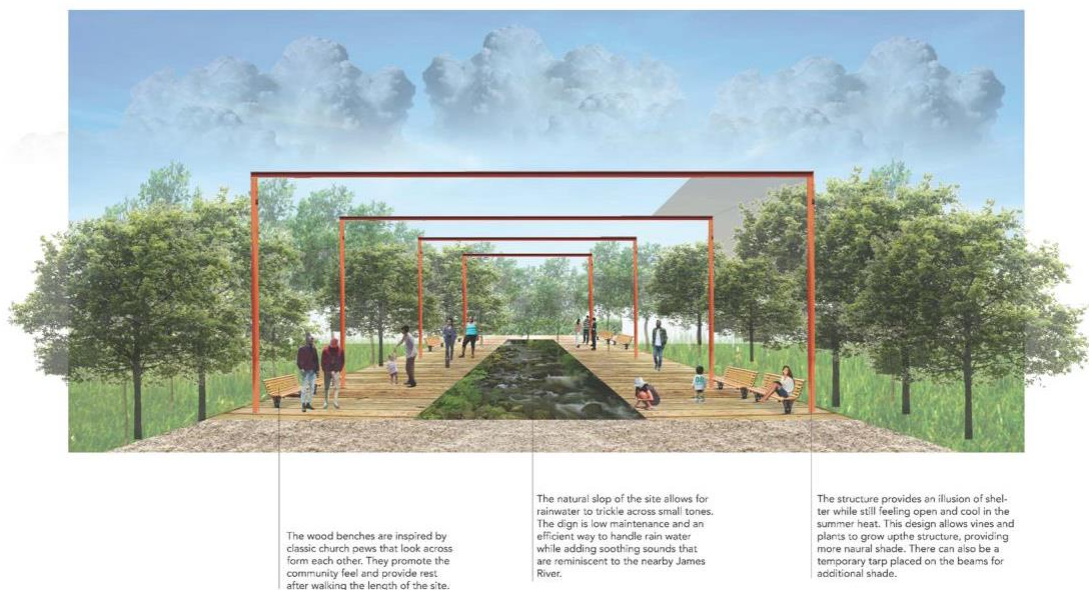
Figure 5. Design Team HCDB, end of semester conceptual design.

In the birth site project, the implementation stage of the "mosaic" condensed the four conceptual designs into one concept, utilized for future fundraising activities. blue // black, the traveling exhibition, supports these activities, beginning its tour in summer 2019 in the Buckingham community.

Figure 6. Interactive timeline exhibit, student Megan Hua.

CONCLUSION

The *mosaic* opens students, citizens, organizations, and community members to the skills to devise empathic *courses of action*, not only during their experiential creation on design projects but throughout the process. The methodology offers a profound human experience by transforming mindsets and cultivating abilities for our divisive climate as participants understand other perspectives while developing designs. As this article demonstrates the process and resultant outcomes, students become better learners, social and community citizens, and ultimately fully aware, empathic design thinkers for the 21st century. Society Member Joe Scruggs of Buckingham captures the experience:

"With all of the negative media about the disconnect of young people in today's society, and the tensions that exist, as we see our country become more and more polarized, this project was a ray of sunlight and hope, a renewed hope that all is not lost and that these young people are living proof of that hope. We can cross bridges of cultural differences and learn from each other."

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[12] Students of Birth Site spring 2018 Design Thinking Seminar ARCH 5500 (Student Name, Design Team Name, Field of Study): Jianna Torre (Humanity, Cognitive Science), Tehmeena Salahin (Humanity, Cognitive Science), Alison Amos, (Humanity, Urban and Environmental Planning), Elizabeth Ayers (Humanity, Political and Social Thought), Caroline Bond (Humanity, Architecture (DT), Architectural History), Andrew Jacobson (Reflections, Latin American Studies and Studio Art), Graham Fraley (Reflections, Urban and Environmental Planning), Alissa Diamond (Reflections, Architecture, PhD in the Constructed Environment), Brian Cameron (HDCB, Political and Social Thought), Emma Hendrix (HDCB, Urban and Environmental Planning), Tyler Chartier (HDCB, Psychology), Ruby Nwaebube (1538, Urban and Environmental Planning), Braelyn Schenk (1538, American Studies and Dance), Elizabeth Zachman (1538, Architecture (DT), Philosophy)

[13] Students of ARCH 4011, fall 2018, blue // black traveling exhibition Design Thinking Studio: Meg Hua - Architecture (BS)/Architectural History (Minor), Cassie Anne Jernigan - Architecture (BS)/Entrepreneurship (Minor), Sherina Jhunjhnuwala - Architecture (BS)/East Asian Studies (Minor), Lily Kelly - Architecture (BS)/Entrepreneurship (Minor), Rohan Kohli - Architecture (BS)/Economics (Minor), Bridget Murphy - Architecture (BS)/Global Sustainability (Minor), Jordan Richardson - Architecture (BS)/Entrepreneurship (Minor), Peyton Spangler - Architecture (BS)/Psychology (Minor), Jennifer Tran - Architecture (BS)/Global Sustainability (Minor)

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PROJECT MANAGEMENT LEARNING: CONNECTING AND ALIGNING WITH TAXONOMIES AND FRAMEWORKS TO IMPROVE PRACTICE

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INTRODUCTION

As the number of project-based companies increases globally (Davies et al., 2011), the need for educated and professionally prepared project managers is also increasing (Ramazani and Jergeas, 2015). However, project management (PM) education faces increasing challenges. One of the biggest is the difficulty to implement learnt knowledge into practical situations (Ramazani and Jergeas, 2015, Córdoba and Piki, 2012, Ojiako et al., 2011). Ramazani and Jergeas (2015) believe current training methods for project practitioners are far behind modern industry needs, a sentiment echoed by Córdoba and Piki (2012). The continually evolving complexity of managing projects (Azim et al., 2010) results in potential gaps between education and the real world, so newly qualified project managers may not be prepared for the challenges of real projects within which they will be immersed.

Academics and educators need to ensure their courses address the evolving PM landscape so that student`s learning activities align to the real world. This paper examines PM learning and some widely known taxonomies and frameworks of learning (Bloom, 1956; Kolb, 1984) to explore both the nature of PM learning and PM education, design and practice. The paper begins by reviewing PM learning before examining some some commonly known learning taxonomies and frameworks of learning. Then through a series of worked examples from the PM classroom, connections/adjustments are made with the taxonomies and "surface" and "deep" learning. The result is a thoughtful re-consideration of the nature of PM learning and how educators should balance and shape learning activities to the demands of the PM world.

PROJECT MANAGEMENT LEARNING

Scholars have identified two types of competencies for PM learning: technical knowledge and soft skills (Ramazani and Jergeas, 2015). Technical knowledge is required for the planning, analysis and execution of actions; soft skills embraces a number of activities, including communication, leadership and team working (Hendarman and Cantner, 2018). Whilst soft skills can be ignored by education institutions and students (Ojiako et al., 2011) and not be assessed by certifications, the importance of both technical and soft skills for an effective project manager should be recognised. The importance

of project management contexts and appropriate skills development also needs to be addressed in educational approaches. Educators should be encouraged by evidence suggesting students are eager for such learning. For example, Ojiako et al. (2011) note that PM students identify transferable skills as important for future careers; with activities such as role play aligning well with this objective as they emphasize interpersonal skills, time management, critical thinking and communication. PM learning should ideally educate the professional practitioners of tomorrow with the knowledge, skills and attributes they will need to prepare them for a career of continual education and reflection. Therefore, laying the groundwork for an individual`s future educational development approach is itself a valuable outcome.

TAXONOMIES OF LEARNING

Bloom`s taxonomy of learning (Bloom, 1956), is widely known, classifying the cognitive domain into six levels (figure 1):
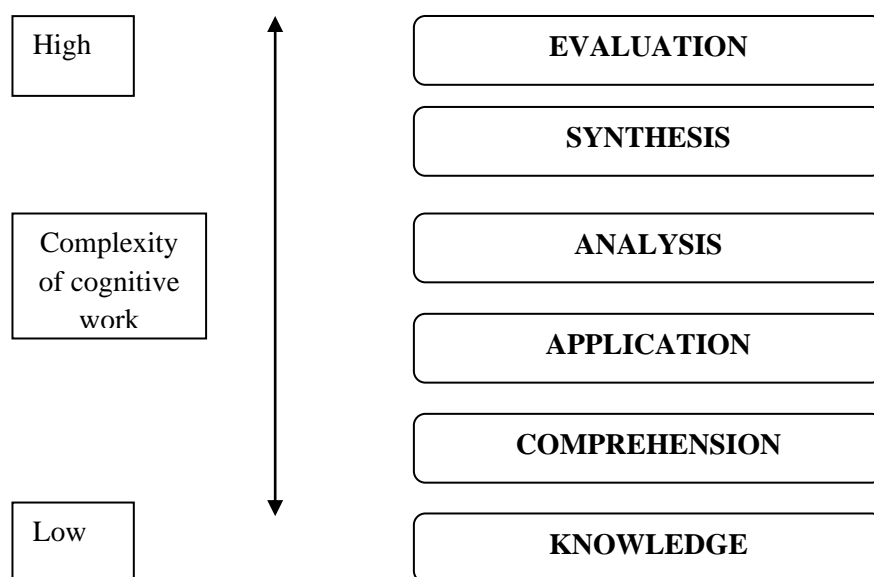
Figure 1: Bloom's Taxonomy (Bloom, 1956)

In Bloom`s taxonomy, the complexities of cognitive work increase from the bottom upwards, each level being essential for students to become critical thinkers (Murphy, 2007). The lowest level (knowledge) is defined as simply remembering of learning materials. Then, comprehension is the ability to understand those materials. Application is the ability to apply knowledge in new situations. Analysis refers to critically analyzing the components, whilst Synthesis and Evaluation are higher order activities requiring deeper levels of cognitive ability: synthesis being the ability to reform components into new entireties which reflect a higher level of critical thinking; evaluation being the ability to judge the value of learning materials. Implicit to Bloom`s taxonomy are "surface" and "deep" levels of learning that potentially map across to the six levels of cognitive work.

Bloom`s taxonomy was developed independently of the world of PM, and so a pertinent question is how applicable is the taxonomy for PM learning? The first four level of Bloom's Taxonomy align closely to Kolb's Experiential Learning Cycle (figure 2) where reflective observation is linked with abstract conceptualization and concrete experience.
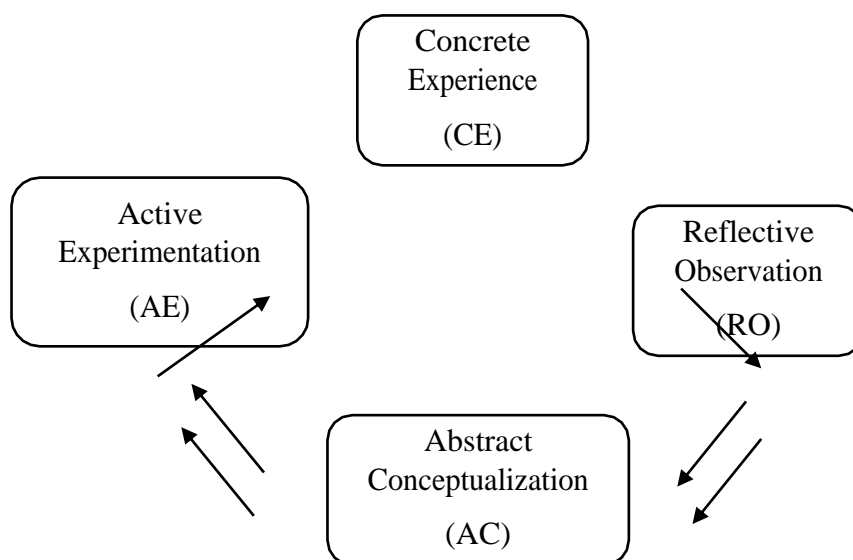
Figure 2. Experiential Learning Cycle (Kolb, 1984)

Kolb's Experiential Learning Cycle suggests that effective learning approaches must follow four-stages (Kolb, 1984): concrete experience, reflective observation, abstract conceptualization and active experimentation. The first stage, concrete experience, refers to having a new experience where students gain new experience by 'doing'. From the perspective of educators, they should design what experience they want their students to gain. The second stage (reflective observation) asks students to review the experience gained in the first stage. This stage is regarded as important as it gives chance to look back and try to transform the experience to students' own understanding (Wain, 2017). The third stage (abstract conceptualization) which is creating new ideas or modifying existing abstract concepts. Then the fourth stage, active experimentation, is applying what students have learnt into practical use. Through this step, students' abilities will be tested, and new experience will be generated. Then, the cycle goes back to the first stage and a closed, complete system is built.

Practitioners and educators would concede that experience is a vital element of learning for any PM professional, with experience of PM issues increasing significantly once a student graduates and begins a career. Experiential learning is defined as the process of learning through experience and always refers to 'learning through reflection by doing' (Patrick, 2011). Based on the characteristics of project management work, scholars suggest experiential learning should be an effective approach for project management education (McCreery, 2003, Chen and Chuang, 2009, Geithner and Menzel, 2016). Simply speaking, experiential learning addresses the importance of learning by 'doing' rather than 'listening' and can be achieved in different forms as experience could be gained by various types of activities (Moore, 2010). The experiential learning theory was developed by Kolb into Experiential Learning Theory (ELT), the foundation of present researches in experiential learning domain (McCarthy, 2010). ELT has been used in higher education for many industries including project management (Kiili, 2005, Chen and Chuang, 2009).

Moore (2010) suggests that experiential learning can be achieved in different forms as experience could be gained by various types of activities, for example, internships, service- learning, cooperative education, study abroad, group-based learning and simulation games. Service-learning refers to out-of-classroom community service activity combined with relevant theories. Among the experiential

learning methods, simulation games (or "role-play") are accepted by higher institutions as easy to conduct and not as expensive and time-consuming as other approaches (Geithner and Menzel, 2016). Combining lectures with simulation games in project management is suggested by many scholars (McCreery, 2003, Richardson, 2014, Jeong and Bozkurt, 2014, Geithner and Menzel, 2016). Simulation games allow students to practice and examine their skills without harming any other party or their career prospects (McCreery, 2003). Multi-player simulation game requires students to work in groups and also contain the advantages of group-based education approach (Geithner and Menzel, 2016). Certainly, role-play is a potentially valuable learning activity for PM students; the creation of a situation which is similar to the real projects for students to apply their knowledge (McCreery, 2003). Compared to individual learning, group-based learning offers the chances for students to practice soft skills like communication, leadership as well as understanding the context (Córdoba and Piki, 2012). These soft skills are not taught by any institution but through group-based learning approaches, students have the chances to improve their soft skills.

Crawford (2006) proposes project management education should shift from 'training-focused' to 'reflective practice'. Córdoba and Piki (2012) agree with Crawford (2006), believing students need chances to reflect on their skills and learn from their colleagues during their education. Indeed, PM has been critiqued as lacking opportunities for reflective learning from project management experiences (Ayas and Zeniuk, 2001): the pressure to start work on the next project task/objective often trumping the need for considered reflection on work just completed. How can we relate Kolb's Experiential Learning Cycle and Bloom's Taxonomy to specific learning activities?

Learning Activities

Biggs and Tang`s (2011) leaning activities chart (figure 3), details various activities (i.e. memorizing; note taking; theorizing, etc.) and is a useful marker against which PM teaching may be aligned. In a similar way to Bloom, Biggs and Tang imply that "deep" learning activities are more valuable than "surface" level activities (e.g. memorizing), arguing that good teaching is about setting up deep learning activities for students to engage in.
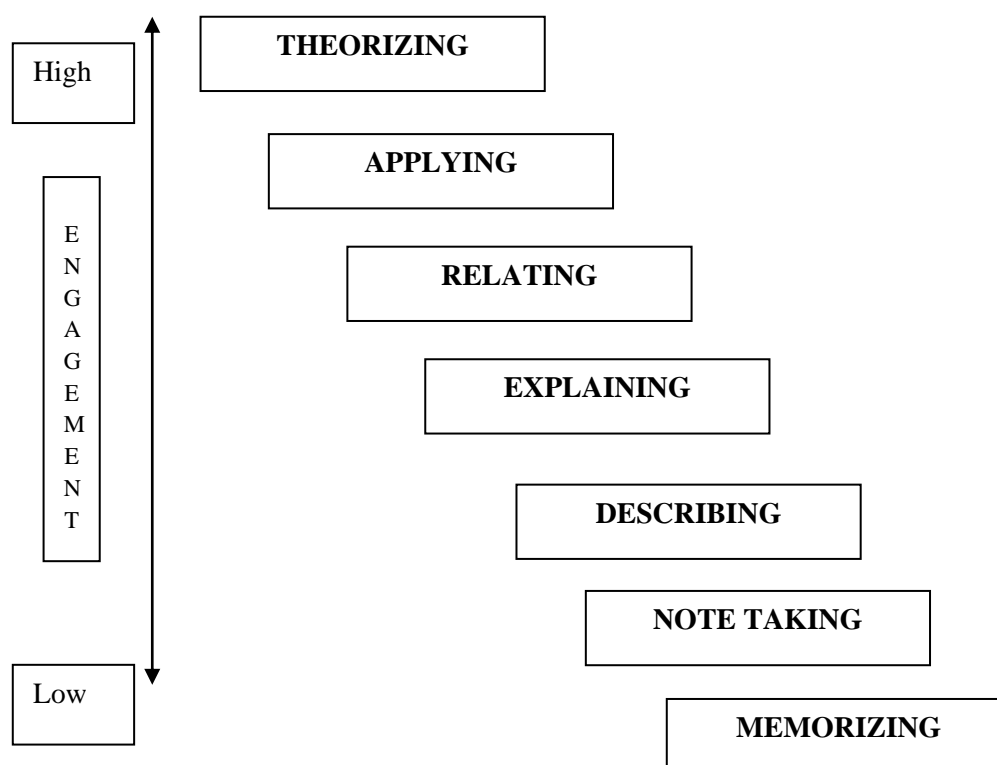
Figure 3: learning activities & required levels of engagement (Biggs and Tang, p.6)

Again, Biggs and Tang`s learning activities chart was developed independently of the world of PM, so the unique characteristics of PM learning (in both educational and professional life) need to be referenced if a fresh taxonomy/framework of learning for PM is to be developed.

PM LEARNING REFLECTIONS

In order to mobilize and connect the ideas presented, the paper now reflects on a series of PM learning issues recognized to be either "surface" or "deep" in nature students may engage with during a course of study. Concepts from Bloom, Kolb and Biggs and Tang are referenced in the discussions.

Surface Learning

The PM professional requires a high level of factual knowledge to be effective. For example, knowledge of company products (i.e. supplier; vendor; item specifics); current legal regulations (e.g. building regulations; planning permissions) and the industry landscape (e.g. Crossrail project completion delayed; fire cladding post-Grenfell disaster in London) should all feed into the knowledge of a modern-day project manager. Acronyms are also prevalent in PM learning. For example, BIM is acronym-heavy, requiring memorizing (Biggs and Tang) and knowledge accumulation (Bloom). Indeed, in PM practice, a shared knowledge of industry facts, terms and acronyms is an essential prerequisite for communication between specialists discussing engineering problems; ignorance of facts/acronyms being potentially embarrassing or damaging. Therefore, memorizing and note taking (i.e. the ability to remember facts/acronyms) is arguably very important. To facilitate this, regular quizzes/tests of student knowledge could be delivered, with the essential importance of refreshing knowledge of facts being made clear to students upfront. In this way, the importance of "surface" levels of learning will become very apparent (i.e. more important than as suggested by Bloom or Biggs and Tang in their taxonomies).

Deep Learning

To gain an appreciation of many complex PM issues (e.g. procurement; contracting; planning and control), deeper learning activities are needed. Such learning requires higher levels of cognitive effort and engagement by students (i.e. evaluation; synthesis; theorizing; applying). What distinguishes PM here is the value of experience in assisting such deep learning work. In fact, an effective experiential learning cycle would mobilize the deep learning activities required to embed knowledge in student`s minds.

These reflections perhaps allow us to tentatively move towards a framework of learning specific for PM learning. In their study of PM education, Ramazani and Jergeas (2015) advocate for more student-centered learning in universities, noting the benefits in fostering independent critical thinking, soft interpersonal skills development and preparing students for the contexts of PM work. They also argue that PM education needs to combine the delivery of generic PM knowledge (e.g. the PM lifecycle; stakeholder management; risk; planning and control) with practical contexts in which students can understand the application of generic knowledge. This means a definite shift from the lecture as a single method of delivery to multiple innovative learning methods and techniques. The importance of preparing students to be reflective practitioners is also intrinsic to Ramazani and Jergeas`s message.

In reality, what makes PM so challenging (and interesting) is its` uniqueness: practitioners must relate their experience and learning to new questions and apply knowledge to new situations all the time. For example, in the process of disentangling a complex engineering problem or working out the logistics of a construction site delivery program, all phases of Bloom`s taxonomy and Biggs and Tang`s experiential learning cycle are relevant, meaning that learning is inherent to PM work itself. Educators must prepare students for such realities, setting up learning activities more aligned to the realities of the PM world.

A more up-front discussion on the nature of learning, knowledge accumulation and personal development with students is worth considering; such work laying the foundation for future learning whilst following a course of study in HE.

In relating the taxonomies of learning of Bloom, Kolb and Biggs and Tang to the world of PM, some assertions can be made:

- "surface" learning activities are as important as "deep" learning activities for the PM student/practitioner.
- effective PM learning should combine generic PM knowledge with practical contextual application.
- effective PM learning should develop interpersonal "soft" skills, critical thinking and experience of project contexts.
- learning in PM is continuous and ongoing throughout a career.

CONCLUSION

The paper explored several taxonomies and frameworks of learning in relation to PM pedagogy. The discussion noted the significance of "surface" and "deep" learning for PM students, the importance of experiential learning and the development of technical skills, interpersonal behaviours and appreciation of context. The paper thus identified the relevance of the taxonomies of learning as well as their shortcomings. Such explorations are important as PM is a dynamic field in constant evolution, and educators need to deliver courses that are relevant and aligned to student and industry needs.

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SYSTEM OF DECODING DESIGN VALUE

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THE NEED TO DEFINE DESIGN VALUE

Design is a process that has an impact not only on technological and non-technological innovations and the economy but also on society at large. The need to measure the socio-economic impact of design and its role alongside other intangible assets in value creation has been identified by the European Commission.[1] Due to "the difficulty in making detailed comparisons in the area of design and development, relatively little detailed comparative work on performance has appeared."[2] The axioms that "design adds value" and that "good design always creates good value"[3] remain only assumptions that we cannot witness or identify. The European Commission has identified the need to define the impact of design on the economy and society.

Decoding the value of design in shaping the economy and society is crucial. The findings of perceived design value among users, such as the Silent Generation, Baby Boomers, Generation X, Millennials, Generation Y and Generation Z, are useful to assess and understand economic, technological, and societal impacts and enable "analysis of upcoming trends."[4] This paper reviews perceived value, emotional attachment, satisfaction, and well-being according to product and service design among wood products, e-services, and digital technology solutions.

VALUE AND EXPERIENCE IN FORMATION OF PERCEIVED DESIGN VALUE

Design is a target-oriented and systematic activity that makes things better for people and produces tangible and intangible benefits. Hence design is a sense-making method toward results that creates happiness and satisfaction.

To prove that design adds value, perceived value needs to be analyzed and measurable, reliable, understandable and comparable according to simple metrics.

Performance indicators as value and experience were chosen to be analyzed for this study. Value may have little to do with a product's market price. Value depends on a product's ability to satisfy user needs or requirements. User thoughts, emotions, and actions are created by tangible, intangible, and aspirational value within their cultural context. Determining the value in interpersonal relationships means understanding human desires and expectations.[5]

Design value is linked with human perception — the ability to see, hear, or become aware of something through the senses or the way in which something is regarded, understood, or interpreted — and reception — the action or process by which people react to something or someone. Consumer expectations are important indicators of customer perception and satisfaction.[6] Perception as a

subjective act is the final link in a chain of related events from the physical world to the perceiver. Subjective approach focuses on one's own evaluation of life and is strongly influenced by expectations, personality, circumstances, aspirations, and interpersonal comparisons.[7] Individual and situational filters are dimensions of a value-creation process that are personal to every individual customer and thus dependent on the situation in which the customer is acting.[8]

Experience is constructed by perceptions[9] that emerge from physical interaction with a product or service. Experience metrics are similar to interaction touchpoints (e.g., micro-events) and can be tied to an aesthetic, meaning, or emotion.[10]

Customer expectations of services and product satisfaction have increased in recent years. As companies can only provide functional value and emotional value propositions,[11] understanding the experience of value creation[12] along with the design value perceived by customers is important. Value is now centered in the experiences of consumers rather than embedded in goods and services.[13]

Experience, and hence value, is individual and unique to every single customer and every single occasion of consumption. The great satisfaction gained from a service or product does not come from the characteristics associated with its basic functional qualities but rather from fulfillment of the need of emotional end-states.[14] An emotional reaction is part of a qualitative and favorable experience.[15]

Created experience and value (Table 1) are described in theories by many attributes.[16] User experience, meaning, and satisfaction are key attributes that, as a result, indicate the perceived design value formed by individual perception. Perception is a medium of receiving emotional experience as perceived value created by aesthetics, interaction touchpoints, and task success in physical interaction.

Indicator	Attributes	Impact
usability	Task success	interaction
	User satisfaction/experience Tolerance to errors	experience
experience	Perceptions Physical interaction Interaction touchpoints Aesthetics	forms frequent users
	Meaning Emotional experience Customer surveys Trend analysis in customer data	customer experience
value	Value for money	economic
	Productivity	cultural
	Competitor analysis	social
	Market segment analysis	loyal customer
	Perceived value Understanding user needs and expectations	technological

Table 1. Design experience and value attributes and performance indicators, adapted from A. Freimane, 2018

Well-being in the broader context includes not only economic performance indicators but also social aspects, individual perception, and satisfaction. In psychology, well-being and happiness are distinguished by the purpose and ability to be identified. Happiness is associated with a sense of satisfaction, but well-being apart from the economy is characterized by positive emotions and positive

relationships, outlining the social well-being dimension. Emotions are actions that make sense in certain circumstances. The expression of emotions requires an object and is dependent on a cognitive understanding and appreciation of that object in relation to ethical and moral values. Diener describes happiness as joy, life satisfaction, positive emotions, the meaning of life, and a general sense of satisfaction, which, according to Seligman, is well-being.[17] Examining it from the product and service design paradigm, experience and value as indicators are the impact factors that create satisfaction, well-being, and happiness.

"Subjectivity, individual values and different angles of view of reality lead people to identify different factors to be considered as elements of well-being,"[18] A person's views can change over time and space, but once people obtain what they did not have before they get used to it. Thus a sense of well-being is transformed into a state of ordinariness.[19] As there is no single definition of well-being, the author has left it to the respondents to decide what the state of satisfaction and well-being is for each of them. Thus, focusing on subjective well-being as people's own evaluation of personal life, perceived design value created by products and services was described and analyzed. As subjective well-being is strongly influenced by expectations, personality, circumstances, aspirations, and interpersonal comparisons,[20] socio-economic analysis will be added in future research.

METHODOLOGY

The findings of this paper are based on open-ended, qualitative online interviews with 200 respondents in Latvia. Questions and interviews aiming to obtain self-reported valuations of some aspects of an individual's life is in accordance with subjective well-being theory.[21] Subjects for the interviews were chosen based on a design, happiness, and value survey;[22] generation theory research and analysis; and the twenty-first century class system.[23] All interviews were carried out between December 2018 and May 2019.

The answers were analyzed for common trends in the respondents' preferences. Respondents were asked to name preferred wood products, e-services, and digital technology solutions in their everyday life and to:

- rank out of three options what creates the most positive experience, satisfaction, and sense of well-being for them in everyday life;
- describe the positive experience, satisfaction, and sense of well-being qualities that the product or service brings them in everyday life;
- describe the values that the product or service brings them in everyday life; and
- describe what creates an emotional attachment to a service so that they return as a client to use it again?

Respondents were asked to describe their methods of acquiring and using new or unknown products or services to identify their habits and behaviors. Perceived value of design indicates important aspects and needs that products and services should provide from the user perspective.

Comparison of three options was queried to discover the socio-economic preferences of users. The answers obtained were used to construct a system for identifying the socio-economic impact of design on the transformation of the knowledge-intensive economy in Latvia.

DECODING SATISFACTION, VALUE, AND EMOTIONAL ATTACHMENT

In keeping with the saying "think globally, act locally," this paper reflects a tiny portion of the postdoctoral research "Identification System of Design Socio-economic Impact Towards

Transformation of Knowledge-intensive Economy in Latvia." Research will analyze evidence-based perceived design value as socio-economic analysis and design impact.

Almost every design solution in the twenty-first century has tended to promise satisfaction, an easier life, and solutions to users' problems. Human beings are overloaded with tangible and intangible life facilitators from every industry and in every form, it is possible to imagine. This urged an investigation of what creates the most satisfying experience in everyday life out of three options: a favorite wood product, e-service, and digital technology solution.

Despite the promotion of timesaving with digitalization, respondents in all generations indicated that the most satisfying experiences in their lives are facilitated by wood products, followed by digital technology solutions.

Comparison of wood products, e-services, and digital technlogy solutions - what creates the most satisfying experience in evryday life

■ Wood product ■ digital technology solution □ e-service

Figure 1. What creates the most satisfying experience in everyday life out of respondents' favorite wood products, e-services, and digital technology solutions; Aija Freimane, 2019

Respondents said that the most satisfying experience is created by wooden spoons and kitchen accessories, such as wooden spatulas and timber chopping boards. The second wood product group that also provided a great and satisfying everyday experience was wood furniture, such as wood tables, beds, and closets. The third group of wood products that provided satisfactory experiences were products that gave users pleasure and joy. In Latvia, it is currently popular to play *kendama* and enjoy outdoor activities, such as longboarding and skimboarding. This wood product group, as it is sustainable, was especially valued by Generation Z.

Digital technology solutions created the second most satisfying experiences, particularly smart phones and Smart-ID. Among Generation Z respondents, Spotify was named as a satisfying everyday experience. However, the most popular answers were "I don't know what a digital technology solution is" or "I don't use it."

Design adds value not only economically but particularly as experiences that users perceive and receive by using products, services, and solutions. Although value is perceived individually and according to personal and cultural experience, there were common indicators of what value the wood products, e-services, and digital technology solutions bring to everyday life in all generations.

When asked what added value to their everyday life was brought by wood products, respondents named experience and usability, enjoyment, memories, functionality, convenience, time-saving, and promptness (Table 2). The value is described as more social and cultural than economic. It is possible to say that perceived design value is more intangible than tangible.

Product-service Received Value by End Users		
Wood Product	**E-service**	**Digital technology solution**
Enjoyment	Saves time	Timesaving
Functionality	Convenience	Connectivity
Coziness	Promptness	Promptness
Memories		
Convenience		

Table 2. What values wood products, e-services, and digital technology solutions create in everyday life, Aija Freimane, 2019

To detail perceived design value, respondents were asked to name product and service qualities that create positive experiences, satisfaction, and a sense of well-being (Table 3). Product-service qualities such as quality itself, aesthetics, understandability, convenience, and accessibility were highlighted as part of efforts to decode perceived design value.

Product Attributes	**Service Attributes**
quality	convenience, comfort, understandability
aesthetics	quality
convenience	friendliness, kindness
usability, functionality	accessibility
	promptness

Table 3. Product and service qualities that create positive experiences, satisfaction, and a sense of well-being, Aija Freimane, 2019

Positive experience is the type of experience that human beings are willing to repeat, thus leading us toward emotional attachment (Table 4). Attributes that provoke emotional attachment to products and services are memories, usefulness, visual appearance, usability, quality, and attitude.

Product Attributes	**Service Attributes**
memories, emotions, linked to a person	quality
practicality, usefulness	attitude
visual appearance	experience
usability, convenience	price
great experience while using	accessibility
does not disappoint; always works	addictiveness
quality	

Table 4: Attributes that provoke emotional attachment to products and services, Aija Freimane, 2019

As innovations and new products or services are offered more frequently and external context reminds about sustainability and global warming, it is important to determine how humans choose to buy or use new or unknown products or services. The findings show that respondents are most likely to buy new or unknown products and services following suggestions or recommendations (30%). The next group (20%) buy or use new or unknown products or services according to need. This shows that end users trust social value. According to previous research,[24] social value is the most important aspect of a product or service.

CONCLUSION

Design adds value as an end result in user perception as perceived value. It is dependent on a product's ability to satisfy user requirements. Tangible or intangible input created or delivered as interactions by products or services with users results in an impact on experience and emotions within a user's cultural and social context. Perception is the final link in a chain of related events from the physical world to the perceiver, comparing theory and user research findings (Table 5).

Theory Research			Research of User Perception		
Indicator	Attributes	Impact	Value	Positive experience, satisfaction, sense of well-being	Emotional attachment
usability	Task success User satisfaction, experience Tolerance to errors	interaction experience	Enjoyment Functionality Coziness Memories **Convenience** **Time-saving** Connectivity Promptness	**Quality** Aesthetics **Convenience** comfort understandability Usability, functionality Friendliness, kindness Accessibility Promptness	Memories, emotions, linked to a person Practicality, usefulness Visual appearance Usability Convenience Great experience while using Does not disappoint Always works **Quality** Attitude Experience Price Accessibility Addictiveness
experience	Perceptions Physical interaction Interaction touchpoints Aesthetics Meaning Emotional experience Customer surveys Trend analysis in customer data	forms frequent users customer experience			
value	Value for money Productivity Competitor analysis Market segment analysis Perceived value Understanding user needs and expectations	economic cultural social loyal customer technological			

Table 5. Deciding perceived design value, Aija Freimane, 2019

Users perceive the design value provided by products and services according to experience and usability. Such indicators as quality, convenience, functionality, understandability, comfort, practicality, usefulness, accessibility, and promptness are directly linked with the usability indicator, as defined in theory. Such attributes as enjoyment, aesthetic, coziness, and quality are highly valued. Indicators and attributes that create experience are the enclose ones as experience is constructed by perceptions and emerges from the physical interaction with a product or service.

Although experience, and hence value, is individual and unique to every single customer and every single occasion of consumption, there are common trends among all user groups and generations. The

great satisfaction gained from a service or product comes from the characteristics associated with its basic functional qualities and aesthetic, thus creating perceived emotional end states.

Determining perceived value in an effort to decode design value requires an understanding of human perception, the way in which something is regarded, understood, or interpreted, and reception — the action or process by which people react to something or someone by fulfilling desires and expectations.

Research identified aspects perceived by users to continue to develop a design identification system that may help businesses and society apply design more deliberately. The study findings contribute to the clarification of the term "design adds value" by proposing aspects of end-user perceived design value.

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NARRATIVE, METAPHOR, FICTION: HOW THEY MIGHT SERVE ARCHITECTURAL EDUCATION

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INTRODUCTION

The methodology developed in this paper focuses on an aspect of the crisis facing architecture today: in the search for a highly technological, sustainable function of architecture, what is built remains disconnected from humanity and environmental reality. In the methodology proposed, place can be perceived and understood through various versions of reality. This allows the role of architecture behind a built work to be interpreted as recognizing the wider complexity of life.

The methodology is introduced through an excerpt from a fictional narrative, one of the eight fictional narratives from the PhD thesis "Liminality, metaphor and place in the farming landscape of Tinos: the village of Kampos",[1] (footnote, Maria Vidali Phd thesis etc).

The Narrative "My Water":

At nightfall when the guests and villagers had gone to honor the party of the newlyweds, peace returned to the village streets. As the streetlights came on, only three dark figures were to be seen in the village streets. They passed by the *choreftra*, the new square, headed towards Holy Trinity's Church and walked hastily to the south end of the village. They were headed without speaking or using any lights to Messaria, making their way towards Iosif's father's field and the spring.

Iosif was among them. And in a low but hasty voice, he started giving instructions to the other two. That night, with all the villagers attending the wedding celebration, Iosif had decided to block the water flow with wood and stones at different points in the gully as it descended towards Loutra village. In this way, it would flow unequally into the properties and cause discord and arguments among the villagers. He thought that this would make everyone feel the way *he* felt about the loss of his water.

The water was cold and the steep gully was surrounded by big stones, rocks and wild plants making their work even more difficult in the darkness. But Iosif had brought torches and fueled by his anger they managed to execute his devilish plan. After an hour, the only thing that could be heard was the water of the spring falling in the gully and filling the small diversion dams that Iosif and his accomplices had built. Now the water would have to travel along a much longer path to reach the village of Loutra.

Sunday morning found the villagers of Kampos in despair. A big flash and then a clap of thunder announced the weather to the villagers before the news on TV. Every farmer's heart started pounding, for they knew that the gully had been blocked. The rain began falling incessantly, becoming heavier

as time passed, and the thunderbolts kept everyone at home with no one available to check the gully. The memory of old *BarbaYannis,* found charred on his mule by a thunderbolt many years ago, was still fresh.

By 6:25 that morning, when first light reached Kampos most of the farmers had reached their fields in Messaria.

"Chaos, what a disaster!" Manolis managed to mutter.

"*Panagia mou,*" exclaimed Nikolas holding his head. Hiding his face, tears started to run down his cheeks when he saw seven of his sheep had swept away by the water. The water had destroyed the boundary walls of his field and had drowned the animals further down in the gully.

This story is set in Kampos, a village of sixty-five inhabitants on the Greek island of Tinos, in the Aegean Sea. In Kampos, one of the oldest farming villages of Tinos with a long agricultural past, the boundaries created by low stone walls and alleyways primarily define the farming landscape that permeates village life.

The topography of the village is dictated by place and time, through seasonal changes, family life, farming, communal and religious life. Though fictional, this excerpt is rooted in a specific area, a particular place on the island and in the world and is an interpretation of it. It allows for an understanding of the village territory which draws in historical, ethnographical and anthropological considerations. It is explained through the vein structure, of the main street and alleys that branch out to the fields. There is an undeniable "hierarchy", rooted in the church and religion, the animals, the farming, the family. But there is also a constant metamorphosis of village life through these hierarchies and this affects places established by the boundaries of communal and private properties, as well as the temporal schedules of habits and customs.

The excerpt about life in Kampos is accompanied by a thorough interpretation of the meaning of property, water, community, conflict, the need for order and coexistence with nature. It is also followed infused by the kind of awareness defined by Emmons, Fenerstein, Dayer and Phinney that "drawing, like storytelling, exists across the ambiguous dimension of reality and fiction".[2] "Architects actively construe stories while drawing; and the ways these stories are constructed are inseparable from the way a project is designed".[3] The book *Confabulations: storytelling in architecture* illustrates Frascari's exploration of architecture as an art that seeks an "expansion of architectural potential, integrating poetry and technique so as to engender, it may be hoped, fabulous buildings".[4] This volume depicts the role of narrative as an essential tool of design. The authors wish this to convey a more substantive understanding of what storytelling may offer to architecture.[5]

Indeed, as is pointed out, "Architects build stories while buildings edify inhabitants. Storytelling and architecture are fundamental forms of what philosopher Nelson Goodman calls 'world making'".[6]

RESEARCH ON AND COMPOSITION OF THE METHODOLOGY

The methodology presented above takes shape in the village life and landscape of a specific case study, that of the farming landscape on Tinos. Initially, boundaries as revealed through texts (old and contemporary contracts), space, movement and habit were explored. These boundaries defined a series of liminal spaces.

In the context of the present work, the term liminality inherently possesses the characteristics and connotations attributed to liminal spaces in architecture, i.e., spaces that represent areas or rather situations allowing

for different co-existing levels of interaction that are both ambiguous and transformable through negotiation. This may also imply communication, conflict or agreements, including a metaphor of what this space can signify in different situations of the villagers' or people's everyday life. Naturally,

this negotiation would not be possible without language and narrative. Language consists in communal metaphors, stories and fictional beliefs that bind and unite a small community within a farming landscape. In contrast to a more urban situation this community still retains a quality of life in close connection with nature, architecture, the private and public realm.

Implementing this Methodology within a Case Study: Theoretical and Philosophical Framework

Initially, the research on the case study of a traditional village was based on archival work of available contracts and testaments. These concerned the island's land and water ownership that reflected specific values and principles, which were seen as components of a special manner of imagining reality. In effect, extended recorded interviews with villagers were undertaken and assembled into an archive of village's oral histories without interference in the narrative, unless the topic became totally irrelevant to the description of village life. This led to a compilation of stories and information about the village and its landscape.

The approach to understanding lived place was influenced by the seminal work of French Philosopher Ricoeur, who describes the world of the text as "a spatio-temporal world of the relationship between universal time and historical time and thus mediated by the places of memory in the same way as relationship between geometric space and inhabited space is mediated by the stories inscribed in these places of memory".[7] The present approach also incorporates an understanding of the importance of "meaningful regionalism" emerging through traces, histories, testimonies and an "authentic dialogue", as described by Pérez-Gómez.[8]

By adopting fiction through the use of phenomenology and hermeneutics, the intention was to introduce another architectural dialogue, based on language, words and narrative, as a new "space of experience".[9] Fictional narratives were created out of the villagers' stories, their spaces, their life with animals, the life they have together. However, the various plots of these narratives and the story excerpt in the introduction are imaginary. Through these one becomes fully aware of Ricoeur's claim about how words in a sentence can reveal a discourse in the world, giving language the function of creating images.[10] One also becomes aware of the poetic metaphor connected to our body in the form of *feeling,* according to Spitzer.[11] The *act of reading*, at the final stages of the work, will enrich it with new interpretations and further allow it to be reinterpreted in new historical contexts.

WHY NARRATIVE, METAPHOR AND FICTION

This case study focusing on the small community in the village of Kampos, led to a development of a perception of what life is like inhabiting the spatial and social complexity of their village architecture. This cannot happen only through architectural drawings, nor by studying descriptions of the village's architecture nor by analyzing anthropological references. Through the narratives that bring out the reality of the village and the imaginary world of its inhabitants, one becomes aware of the value of metaphor as the natural language of a communal life that is inextricably linked to the natural and built environment. Stories connect language with the mimetic action, the habit, which in turn connects our physical and mental experience with the environment, place and space.

The fictional narrative was adopted in order to discover and reveal the truth through fiction/story/myth, as proposed by Ricoeur: who sees the "mediating role" of fiction as a weaving procedure of the different elements that make up life. This complexity of life is what narrative tries to imitate.[12] Hence, in each fictional narrative, there is an interpretation based on the spatial organization, again followed through in fiction with a hermeneutical intention and a view to revealing another reality of life in each place. Hermeneutics, anthropology and philosophy are used to approach

place from different perspectives and provide another version of its reality through the story's interpretation.

During the last year, this methodology was used in a Contemporary Urbanism course, using the city of Athens as a case study. Students from American universities that were visiting Athens for the first time learned about the history of the city, the theories that focused on specific urban and social issues and the methodology as described above. Local narratives, field trips to certain areas of specific historical, urban and social interest, interviews with the locals allowed them to gain experience and formulate their own understanding of the city. This became evident through their own fictional narratives as a composite of their historical, social, ethical, spatial and urban perception of a city that they had never been to before. Reality took shape through a fictional/imaginary plot that helped anchor their experience. Excerpts from a student's narrative: "Even though the crisis was ostensibly masked by upscale shops, there were small lapses that cracked its pristine image: the scarfed homeless woman holding a perfunctory sign; generic *koulouri* stalls in competition with each other." "Orange trees carelessly dropped their fruits as pink bougainvilleas teased the walls.

Young Greeks littered the steps over coffee and cigarettes, with no real boundaries between private and public space."

The same methodology was used with architecture students at the University of Thessaly. Based on traditional village architecture, the course sought answers on what a young architect should know beyond the structure of a building, how he could understand the complexity of life in order to analyse and understand an existing spatial and social situation in depth before beginning the design process.

This methodology led to a structure of both metamorphosis and concreteness in the village becomes words through narrative and metaphor, unveiling a different manner of perceiving and interpreting the local topography and becoming an initial formal form of a local narrative. Through this research, it became clear that the reality of the village could be perceived and understood through the combination of its different versions. This kind of investigation provides a way of bringing an intensely human and intimate face to what dwelling means, which is a critical aspect of design for the world we live in today.

Why this Methodology is Important as a Paradigm for Design Studio Education - Conclusion

This methodology and the study of Kampos led to a different understanding of space, of place and of deeply embedded ways of life. This approach may be of particular importance at a time when architects, planners and design professionals are preoccupied with ecological and sustainability issues, struggling to find novel and ever more efficient solutions. Despite the changes dictated by external imperatives, these ways of life in the village continue to contribute to a psychologically and physically healthy and fulfilling lifestyle today, one that extend from the private sphere to the public realm.

This research and methodology provided a new perspective as to how Kearney, with reference to Ricoeur's work, explores the ability of language to open up to new worlds, not as the sum total of subjectivities, but through the productive linguistic imagination.[13] It is "the metaphorical imagination", he states, that "not only combines the verbal and non-verbal, it also produces new meaning by confronting a literal with a figurative sense".[14] Bringing together the meaning of narrative, imagination and interpretation, as practiced in the village of Kampos, its public and private realm, but also its landscape, one experiences how "semantic innovation", also mentioned by "the linguistic (hermeneutic) imagination" according to Pérez-Gómez, allows us to identify the relationship between *"tradition and innovation"*, which is indispensable to the "proper social

functioning of architecture".[15] Imagination is common to both language -as narrative/ fiction/ story-and architecture.

In this work, metaphor, narrative and fiction are presented as tools for architects towards a broader understanding of what the world that we design for really is. They are introduced as a way of escaping from the preoccupation of what this world should be according to contemporary social and political commandments, given that urban rules also fail to reflect a deep understanding of the reality of a place. Metaphor, narrative and fiction allow for different more grounded versions of reality to emerge. They equip architects with a way of interpreting the local tradition or urban structure into a contemporary way of living and innovation, without responding to architecture and dwelling through form and fashion. Instead, they force them to tap more into the social and ethical function of architecture, a "meaningful regionalism" related to humans and the environment.

NOTES

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THE MEANING IN SEEING: VISUAL SUSTAINABILITY IN THE BUILT ENVIRONMENT

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INTRODUCTION

This paper is the meaning in seeing and is based on the concept of visual sustainability. It is divided into three parts. Firstly, the key concept; followed by uncertainties and ambiguities around urban visual meaning; and lastly, a declaration of visual meaning. This paper is therefore an assemblage of ideas around those three main themes and will make the argument about the significance of a concept such as visual sustainability; not only in a pedagogical sense but also in what the underlying philosophy means for our understanding of the skills needed in educating future generations. Throughout this paper, the concept of visual meaning in our urban is considered an extension of the argument for meaning in education, because we reflect a basic human condition: that we all intuitively understand the creativity involved in thinking to make and making to think. We are all epistemically grounded through shared knowledge, exchange of ideas, and participation in a crossover embracing theoretical, philosophical, empirical and practical or heuristic knowledge.

The key concept

In introducing the key concept of this paper, we can start with a question. And it's based on Searle's theory [1] that a piece of paper is transformed into money by a simple status function declaration. The question is: how do we compare the transaction of an intangible service or product, with how we experience our urban? If one thinks about it, that piece of paper with some ink on it represents something intangible; it is transacted for something intangible; and the construct which has been exchanged, is instantly consumed in an intangible process. So, in our urban, isn't there something similar to be said for how we transact and consume surrounding visual elements? Because isn't one transaction every bit as real as the other? The transactions where we consume visual elements are, as far as one can tell, every bit as real as the transactions where we consume intangible services. And is this not equally true for education? Education consists of transactions and is, it can be argued, in the first instance deeply rooted in the visual world.

The main idea in this paper then is that, whether we like it or not, just like money our visual world is made up of transactions. It can be argued that the sooner we realize the practicality of this, the sooner our designs will align better, not only with the construction industry and the business world, but with underlying theory too. And being made up of transactions, in a way of course that's exactly what we do; through linkage, orienting, and more. And the currency we use is meaning. Meaning affects

education and practice in different ways. What is of particular interest to this study is the idea of locating these transactions of meaning and wrapping them up in a concept called visual sustainability. From this vantage point it can thus be argued that education and practice can coexist unambiguously.

VISUAL UNCERTAINTIES

As is the nature of life, there are always obstacles to the way we see things. In a world of visual ambiguity, we are often caught up in the unfamiliar or unrecognisable or alienating (Salingaros et al.). There is thus a need for visual meaning to play a more influential role in education and modern-day sustainability. We need to discover more about how and why we latch on to the visual elements around us, what exactly we latch on to, and for how long. Some people think we use memory. In 'The Art of Seeing', an interview with artist David Hockney, he describes how we always see with memory. And because each person's memory is a bit different, we can't be looking at the same things, he notes.[2]

What's striking about one artist's intuition, is this idea then of how these days especially, life seems to be more about the things that we don't see. We don't or can't see uncertainty; linkage; orienting; or memory. What we see is the result of an interaction, explained through Kelley's analysis of perception of causality.[3]

But for the main message of this presentation, we're going to hook in with Lefebvre's concept of the invisible needs[4] around us. And the argument will be that these are contained in structures of networks, assemblage, and conditions of satisfaction. In thinking about how important these structures are for seeing, we can think also of how much of the urban we're really absent from. And not just because architects are only involved in about 10% of all construction according to Cuthbert,[5] but isn't it also because we've stopped knowing how to see things; that we're missing out on the opportunities that may be available to us in education as well as practice?

Conceptual relationships

In this first section we'll look at a number of conceptual relationships, at crossroads of uncertainty. For Wittgenstein, perception contains thought. And thought contains perception. We also follow the logic of De Landa, where we see how it's possible for condition states to exist. That when analysed by a concept of dials or levers can produce qualitatively different phases in urban phenomenon.[6] So, using this technique, we can understand more of the things and events that we can't see. By gradations of evidence. For example, between perception and thought. Or visual elements and meaning. Or in the durability of visual meaning over time. This holds equally true for education. In the difference between learning in different condition states, for example, in a state of increased awareness.

In this regard we can turn to the mechanics of sight and the prefrontal cortex. That non-autopoietic or non-self-regulating 10% devoted to attentiveness that Stafford talks about,[7] and which operates within the larger orbit of perception's five senses. Visuals and non-visuals are a mixed bag. Creatively different. But aren't we all equally capable of extracting information from the surrounding invisible urban interactions? So right at the beginning, before we even put our design cap on, we should be thinking of these invisible interactions because there is arguably already plenty of design out there - working away behind the scenes. And it can be argued that sometimes what we don't need is more design, especially contrived, but only to use what exists. And in doing so we create what is arguably a far richer meaning; one that is deeply embedded within the surrounding context. Is this not ultimately the point of education?

Barbara Stafford talks about a pedagogy of voluntary attentiveness.[8] The long conscious look. Of slowness, that is so important in education. Stafford's thought process can be reconciled with

Wittgenstein, in understanding how slow looking contains slow thinking. Which helps us pay attention to the surrounding invisible interactions in the classroom and outside it. Because in many ways our urban is the most influential teacher of us all.

Conceptual relationships that exist as mental roadblocks or states of ambiguity prevent us from paying attention to and seeing more of our urban. This is also true of another uncertainty we encounter in the urban which is in how visual difference contrasts with visual indifference. And compounding the problem is rapid urbanisation and rapid isolation. Salingaros points out how if the information we seek in our urban is not there, it drives us to leave.[9] But it is not only the physical rejection, but also the toll of psychological and health effects. Think here of the worldwide phenomenon of mass relocation; 'cutting-and-pasting' memory and meaning at the scale of entire city populations.

The difficulties we face are compounded by predictions, not only that by 2050 over 75% of the world's population will be urbanised,[10] but by 2033 in England some 20 percent will be living alone.[11] And if the trend of alienation remains largely unchecked it will compromise social integrity, by biasing the correlation that arguably exists between visual meaning and conditions of alienation. Which of course is unsustainable.

Then there is fractal-like assemblage in our urban. In Figure 1 we can get a sense of sustainability of networks, assemblage, conditions of satisfaction, and collective intentionality. As well as of power law behaviour through fractal-like self-similarity, that we so admire in nature.

Newark, New Jersey
c.1874

Newark, England
c.1646

Newark, New Jersey
Self-similarity

Newark, England

Figure 1. Fractal-like assemblage
(Top LHS: Image © by C. R. Parsons, Parsons & Atwater, New York, No known restrictions on publication;[12] Top RHS: Image © Fleming Woelfell 3D Imaging).[13]

But at another crossroad of uncertainty, where abstraction meets distraction (a concept used by Stafford) here, seductive architecture aside, it is difficult to see in what sense invisible needs are being met (Figure 2). This too is unsustainable. Because have we not ourselves become a little more invisible? The pedagogical relevance of invisibility is a discussion that can be held beyond the remit of this short paper.

673 Broad Street
Newark, N.J. 2016

673 Broad Street
Newark, N.J. 1993

Figure 2. Have we not ourselves become a little more invisible?
Images © Camilo J Vergara).[14]

Turning now to modern-day sustainability (which in itself is a form of ongoing education) we can see how sustainability is measured in ambiguous ways.[15] Not only are Sustainability Indicators (SIs) are difficult to understand but modern-day sustainability has been unable to stop social destruction through the isolating effects of large-scale modern developments. If one looks at the related Sustainable Development Goals (SDGs)[16] it becomes clear how difficult it is to extract out any sense of visual meaning. Or of the existence of a concept of visual sustainability. What then is driving this absence, and our ability to change?

Technology certainly helps us change. But it's not driving the absence. An iPad helps Hockney explore, but tech is not the glue. That instead we need to reset the conversation. From sustainability driven by itself to sustainability driven by pedagogy. At a crossroad where process meets place one can ask, what is the primary container of meaning? The environment, or the object in the environment? The most popular street on Instagram gives us a clue.[17] Where objects in an environment celebrate relational difference. A timely reminder again of Salingaros: that we should be looking forward to a society that abandons architecture as a cult and replaces it with architecture as a field based on logical reflection.[18]

DECLARATION OF MEANING

Having looked at a number of conceptual relationships around uncertainty let's turn now to a declaration of meaning and some transactions that may be pedagogically important. The idea that our visual world is made up of transactions is a useful one. That there is a sense of some form of social contract implied; creating a visually sustainable environment in return for an investment that only people can make. Visual sustainability then meant simply. Which we can describe as the process by which people are sustained and enriched in daily life through the visual relationship they hold dear to their surroundings.

And it's all about context.

The context then of a declaration of meaning in this study, is in how visuals and non-visuals evaluate and structure our cities. But here's an important distinction. Farmers don't grow wheat; they create the conditions for wheat to grow.[19] It is the same for education, which provides the conditions for minds to grow.[20] This should be no different for professionals. That is the way we should be oriented in our urban. The importance of this cannot be overstated; in that we don't create cities, we create the conditions for people to thrive. The conditions to thrive create great cities. And these conditions,

evident in great cities, can be found, it is argued, in visual sustainability. Satisfy the process by which people are sustained and enriched in daily life through the visual relationship held dear, and we satisfy these conditions. So, what are these conditions?

A spectrum of meaning

The argument is that these conditions, while themselves the result of non-linear and unpredictable interactions, are revealed in urban phenomenon that appear to us to exist as a linear process, along a spectrum of meaning. This spectrum enables visuals and non-visuals to adopt a strategy of relational meaning, by creatively, according to Gibson, finding opportunity in objects and processes that were not part of the original intention.[21] So that people can locate concepts and understand where they are in a particular process. The 'how' is important to enable young professionals to embrace the building industry in a network of meaning.

The how it is argued, can ironically be found in philosophy, not technology. In the glue advocated by Searle,[22] which holds both visible and invisible together, bypassing ambiguity in both education and professional practice. So then just as with the science of money, we can look forward towards a science of the urban, where we transact with visual meaning. And that meaning is fundamental to pedagogical relevance.

Figure 3. An iterative process of continuous improvement in visual sustainability.
Resetting priorities: replacing sustainability driven by sustainability, with sustainability driven by pedagogy (Image © Author, 2019).

Transacting meaning through assemblages

Moving on to some transactions of meaning in assemblages, we see numerous examples in everyday life of epistemic objectivity of ontologically subjective conditions.[23] Money, the menu and those sorts of things. Architecture for example is not the centre of the universe, but instead plays a supporting, yet invaluable role in the magic of emergent urban conditions. We can talk about Searle's conditions of satisfaction as one example. That it shouldn't be enough just to say that it's raining. It should be raining. Now this may seem obvious but how evident is it in much of the urban and as well as in our education?

It shouldn't be enough for a street lined with buildings to say, 'I'm a street that means something to you because I have objects called buildings.' But that the conditions of satisfaction include that the street actually has meaning and value. Where we make something the case: 'I'm a street that is relevant to you, with memory and meaning'; or 'I'm a street by which you are sustained and enriched in daily life through the visual relationship you hold dear.'

In our urban we see evidence of connectivity of meaning; complex interactions; emergent properties; and delight in unpredictability. In looking to a pedagogy of linkage and orienting processes, in invisible interactions and use of space, what of this is teachable and what of this is being taught? In urban design, linkage information is used for people to cross from one space to another.[24] So too it is

in a spectrum of meaning. Where an assemblage of meaning is slowly being enriched and changed over time. To the point that it becomes sustainable and fixed in our memory; and we use these assemblages to get around.

CONCLUSION

In conclusion we will draw together some of the main points on a way forward. Visual sustainability is fundamental to pedagogical thinking. As we step away from the self-fulfilling prophecy of sustainability driven by itself. We can start looking at new ways around old ways of doing things. Using building blocks that Holland talks about.[25] Around the concept of invisible needs that Lefebvre talks about.[26] Of associations and relationships. Comfort and affordance. And so, as we look towards the environment that we're embedded in, instead of seeing separate physical objects, we see relationships. In conditions of satisfaction; fractal simplicity; and invisible needs.

Ultimately, what's most important really, is that if meaning is the luggage, then sustainability is the leaving. The luggage is 'hooking in' with the surroundings. The leaving transports that collective meaning into the future. For someone else to hook into. This paper argues that visual meaning is activated at the base of Maslow's hierarchy of human needs. Because people will place self-identity above even survival.[27]

In summarising around the concept of the meaning in seeing, what's not there and why this is important, we have explored meaning as an assemblage of ideas. We've broadly covered the key concept; some visual uncertainties in the urban; and a declaration of meaning. We have explored ideas around how our urban is a reflection of our education; uncertainty; ambiguity; perception-thought; attentiveness; collective intentionality; conditions of satisfaction; fractal-like assemblage; knowing how, not just what; creating the conditions for growth; process versus place; not objects but relationships; reconciling visuals and non-visuals; and finally, a spectrum of meaning.

Future research should focus on understanding the importance of our visual world to pedagogy, our physical world and modern-day sustainability. This can be done by way of visual meaning.

NOTES

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ARCHITECTURE AND ART IN CHILD DEVELOPMENT

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INTRODUCTION

Art is a cultural manifestation that must be promoted from the earliest ages. Children should be allowed not only to achieve freedom of aesthetic and artistic enjoyment, but also to increase their knowledge on oral and written expression of the world that surrounds them. However, art continues to be a subject relegated as only entertainment in school programs. To be able to explore children's creativity, a change of attitudes and habits must take place.

Creativity, in Roget's New Millennium Thesaurus, is artistry, cleverness, genius, imagination, imaginativeness, ingenuity, inspiration, inventiveness, originality, resourcefulness, talent, vision (Creativity, wd). For Gardner, Creativity can be defined by something *"who regularly solves problems, fashions products, or defines new questions in a domain in a way that is initially considered novel but that ultimately becomes accepted in a particular cultural setting"*[1].

According to Csikszentmihalyi *"creativity results from the interaction of a system composed of three elements: a culture that contains symbolic rules, a person who brings novelty into the symbolic domain, and a field of experts who recognize and validate the innovation"*[2].

After completing the master thesis entitled "The Approach to the Work of Art in a Kindergarten classroom (with children from 5-6 years old)", we realized how stimulating these dynamics between children and art can be inside a classroom. There are many successful studies about the importance of systematic and planned approaches to arts in pre-school and throughout the education. However, much remains to be done when it comes to the children's contact with art in general. In order to develop an aesthetic and visual notion of what art is, the children should be provided with access to different activities that promote visual understanding of culture and art expression, stimulating creativity and an idea of beauty and sensitivity. Teachers can help students developing many skills and promote important attitudes to the creative process and their consequent aesthetic education, by promoting a free experience of prejudice and full of inspiration inside the classroom.

Every child has a different awareness of the world around them: every toy, every book, every furniture has a shape, a color, a pattern that can induce happiness, comfort and imagination. A child's room is full of artistic manifestations.

If we think about everything that surrounds us, there are always aesthetic aspects implicit in our life. The colors presented in different houses or, the colors of each child's room, the textures that decorate it

and the patterns that make them different, the shape that each toy has, everything has an aesthetic side and we can't imagine what it would be the world without these small artistic and cultural manifestations in each society.

PRESENTATION OF OUR STUDIO

Based on our professional experience with art projects, we assume the role of an artistic educator in an arts studio in Lisbon's City Hall (Portugal). We work daily with projects focused on the development of children interacting with works of art. Although the results are being successful, we intend to go further with this project and to extend it. Taking it to the most disadvantage neighborhoods of Lisbon. We have already presented our project to our hierarchical superior and we are waiting for it to be authorized.

The Art Studio in which I currently work "Let's go to the museum" has three different aesthetic projects for three different age ranges: "Paint and Doodle: Let's Try" for three years old; "Land Art: Discover the World" for four years old and "Let's Go to the Museum?" aimed to children between 5-6 years old. The sessions are currently presented weekly and last about ninety minutes. These sessions are outlined and planned until the end of July 2019 despite having a total of seventy-two children enrolled in the Art Studio, only 21 make part of "Let's go the museum".

However, we are interested in creating a different atelier, in order to complete this one that already started. It is planned to start in the next school year (2019/2020). This new project will be called "Architecture and Art in Child Development", where two groups of students from different ages: 6-10 years old and 11-15 years old. This is a different concept, changing the age ranges from pre-school to junior kids. In this space designed by us, we will make a parallel between the works of art of museums and all works created from the hands of students enrolled in the studio. In this space, the students work mainly on the visual arts and also focus on the contemporaneity of architecture. "Let's go to the museum "has had a huge success and an excellent repercussion abroad the school and surrounding areas.

The visual path of the studio initially passes through the approach of numerous works of art and their "deconstruction". Then, we move to the practical application in an external context. We can quickly see decorated trees like Klimt Tree of Life or school walls with Kadinsky concentric circles. The creative activities linked to works of art allow thrash children to stimulate the self-concept and self-esteem, also allowing them to "a exteriorization of emotions and feelings and the sublimation of the instincts"[3]

Above all, the results from the sessions should have a direct and practical application on the whole creative act. This act must presuppose the accomplishment of something new that suits the context in which it emerges (Tod Lubart, 2007). Everything that we will do in this studio will have a goal to decorate and construct something that this town doesn't have. This means that the individuals are going to be able to combine ideas that had never been done before and by that we are giving rise to knowledge and innovating by creating something new. Winnicott says that "*It is creative apperception more than anything else that makes the individual feel that life is worth living*"[4].

We will now explain how the sessions of the "Architecture and Art in Child Development" will happen.

All ateliers will start with a wheel talk about a work of art.

We will quickly move from the oral approach to a practical application related to the work presented. Of course, each work can give a motto for one or several sessions, depending on the practical activity that one wants to carry out. If the idea is to decorate a bus stop that is visibly in bad shape, the students of this atelier will certainly have a few days to work on it.

Some activities will be in group and others will be individual. What is important is that they can absorb what they are seeing and turn it to "work "on their free way of thinking.

Throughout these visual paths the children will have contact with art matters that allows them to acquire some oral fluency when confronted with any work of art: line, shadow, painting, engraving, drawing, sculpture, pointillism, abstraction, surrealism, among others. They also come into contact with more architectural issues, since the final creative work will always have a practical application, as previously mentioned, and preferably have visibility and utility for the whole area where the studio will be installed. The children and young people will have for example to design or redecorate a public garden next to the studio and that requires the construction of benches and their ergonomic study, the arrangement in which they will plant or not some flowers and all kind of issues related to landscape architecture. Of course, all this redecoration would always be based on a work of art or an artist, as if the artist itself had been decorating this same garden. The idea is to create an inseparable link between the works studied and the practical application that these can and should have in this studio.

This atelier will have a strong social component and there will be free expression for the children to communicate. There are many times when it is only through art that we get manifestations of something that torments us. Art is a way of communication and liberation for the world. Robert Dottrens (1978) stresses that speaking in artistic expression is talking about aesthetic aspects, giving personal expression a prominent place does not mean that it competes with the school to turn students into artists.

It should rather allow them freedom of aesthetic performance and thought.

Children's feelings about a "work of art" can have different kinds of views. From admiration to misunderstanding of their meaning. That is why the approach of the work of art must begin even at the preschool ages. Csikszentmihalyi, in his book Flow, transcribes a commentary by an observer, which states that a work of art allows us to have a sudden perception and an understanding of the world (Csikszentmihalyi, 2009).

Within the theme of the relationship that the child establishes with the work of art, pioneering studies of extreme importance have been made, such as the Visual Thinking Strategies defended by Abigail Housen and Philip Yenawine (2001) and the stages of aesthetic development of Michael Parsons (1991), among others.

Victor Lowenfeld and Brittain (1977) have also a special place on the emphasis of the arts as restrictions on a social side. In none of these projects do these activities depart from the work of art to a practical application. It is focused on the reconstruction and rehabilitation.

However, in our project there are two unshakable topics: the works of art and their application through architectural or decoration projects.

In any of these two the artistic manifestations will always be present, and the child will express itself in everything he does. They will leave impressed their feelings, emotions and aesthetic vision. Their own creativity will take place in everything that they will do. Only then can art receive maximum fullness, for through it you can reveal and exteriorise all your problems.

The importance of peer interactions

This interaction and acceptance of opinions between peers was really a prime factor for good understanding and future integration in different groups and also for the development of personality itself. Knowing how to listen to the others is indeed a sign of maturity and inner growth. The improvement of the interactions between peers was one of the positive aspects that we retained of this action. The spontaneous verbal communication among students that have different ages or not, results in peer teaching (Cooper, Marquis & Ayer-Lopez, 1982).

The children cooperate with each other basing some of their answers on something that others had already said. Piaget says at one point that cooperation does not require anything other than the processes of intellectual or moral exchange between those who cooperate (Piaget, 2013). Focusing on the fact that opinions can be heard from a particular group without this in general, compromising the individual only consolidates the opinion that each person has through the exchange of ideas and theories. Michael Parsons (1991) argues that different people react in different ways to the same works of art orienting each one of them to evaluate the picture by the characteristics that they consider to be more or less important for themselves. Of course, according to how they interpreted the work presented they will have a different way of thinking about a practical application of it. The important thing is to know how to listen and respect the opinion of others.

This atelier will follow by this order of goals:

Figure 1.

Figure 2.

c)

Promote free expression and dynamics to a better resolution of problems inside each neighborhood or parish

Allow all the ideas to be heard and always let the children be involved in some part of the project

Encourage all children to participate, listening to them and giving them voice to speak what they think

Achieving creativity through game plays, created by children with the aim of creating a relationship between the students.

Dynamic activities such as Role play and pedagogical games

Figure 3.

D)

Acquire knowledge about the different techniques approached, for example: Plastic art will provide an enrichment at visual language

Using technical terms for each activity to generate more knowledge

Encourage the typical art language

Creating all kinds of publicity to announce my project;

Plastic activities : painting with different materials; recycle ; reuse materials; collages ; graphic compositions of natural elements

Figure 4.

E)

Promote the associativism and fellowship

Encourage meetings between children from the different expression studios

Creating projects for all ages

Promote the cooperation and self help between the people involved in the project and promote bonding inside the team

Figure 5.

Schedule

This workshop will be two hours during the week and two hours on Saturday because we believe it will be the children and young people wanting more time with us. As a rule, when children feel truly involved in a project, they always want to participate in their whole conception because they know that afterwards they will see all their personal investment come to real life.

In any case, the workshops will be of free frequency and will only be attended by children who wish or whose relatives they want (here we refer to the age group of 6 to 10 since the group of 11 to 15 will certainly have a more "active" voice to decide if they want to join or not).

Material resources

This workshop will count with the support of the community, accepting all kinds of donations and materials that can be recycled. The important thing is to break from what you have and only acquire what is really essential to the construction / decoration do something new.

Multidisciplinary team

The "Architecture and art in child development" will have a team composed by an artistic educator, an architect and two assistants. The technical team will always meet before the sessions take place and after they finish.

CONCLUSION AND FUTURE PERSPECTIVE

We believe that the interaction between children and works of art have benefits for the individual level, with a view to cognitive and aesthetic development.

The dialogues around the works stimulate the learning of new aesthetic concepts, enriching not only knowledge but vocabulary for the children. Also makes them more in tune with the world around them.

The capacity for aesthetic appreciation will create a contact between the child and the work of art. We also believe that this workshop will play a role key in social integration between peers as they will have to learn to listen, respect and integrate peers' ideas with their own. They will shape their own ideas and share them with others, giving a contribution to the group.

As they play, they will learn to accept each other's opinion better and this will make them more resilient and more adaptable giving them useful skills that are essential for the future life.

In addition, with the support of the Training Department of the Lisbon City Council, with whom we have already made the necessary contacts, we also intend to train teachers and other professionals who are in contact with children, so that they can raise awareness of these approaches.

NOTES

[1] Howard Gardner, *Creating Minds*. (New York: Basic Books, 1993), p.35.
[2] Mihaly Csikszentmihalyi, *Creativity: Flow and the Psychology of Discovery and Invention*. (New York: HarperCollins, 1996), p.6.
[3] Maria Eugénia Carvalho Branco, *Vida, Pensamento E Obra De João Dos Santos*. (Lisboa: Livros Horizonte, 2000), p.156.
[4] Donald Woods Winnicott, *Playing And Reality*: D.W. Winnicott. (London: Tavistock, 1971), p. 65.

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THE TRANSFORMATIVE USE OF WORK-BASED LEARNING IN THE DESIGN STUDIO: CONNECTING ACADEMIA AND ARCHITECTURAL PRACTICE

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INTRODUCTION

Historically, the teaching and practice of architecture have undergone changes. From antiquity to the twentieth century there have been three key moments in history that have defined the instruction of the experts and their exercise.[1] On the one hand, the learning/teaching of architecture has been changing depending on the type of training/education received, the place where knowledge was acquired and the way in which the profession was carried out. On the other hand, in the practice of architecture there have also been adjustments related to the type of building, the representation techniques, the architects' role and the working methods. In addition, these changes have also contributed to establishing multiple interrelationships between the learning/teaching of architecture and its practice.

The Contemporary Architectural Practice

At the beginning of the twenty-first century, it seems that the practice of architecture is experiencing again another moment of fundamental transformation.[2] In the past two decades, engineering and architectural studios have had to reinvent themselves to adapt to new social, technological and productive demands. Thus, new forms of professional practice have emerged globally. The practice of architecture has become a holistic and interdisciplinary process because new collaborative and network methods (integrated practice and virtual communities) have been adopted.[3] The intensive use of digital technologies as tools of social empowerment has helped to access, create and disseminate architectural knowledge internationally.[4]The acceptance of new production systems (BIM, parametric design technology and digital fabrication) has revolutionized the design and management procedures and has produced a bio-digital architecture.[5] The consolidation of social projects with a greater involvement of public and private agents throughout the entire work process has strongly link social needs with praxis.[6] Finally, the studios funded by women has gained ground in recent years promoting a more inclusive architecture which escapes from the traditional and patriarchal work patterns and conceptions.[7]

In conclusion, what are the effects of these changes in the profession? The professional activity has diversified and, therefore, has contributed to expanding the traditional role of architects.[8] They are no longer privileged professionals capable of bringing together a set of artistic and technical knowledge, but have become professionals who interact with other experts with a more specialized expertise. Consequently, the knowledge that architects must obtain to act professionally in these new working environments are also changing. At present, they must acquire the necessary competences to work temporarily in interdisciplinary teams which can be geographically distributed around the world, to achieve a high instrumental and social mastery of digital technologies, to develop a broad perspective of the professional problems and to combine diverse abilities related to the design, research, management and consultancy of architectural projects.

Challenges in Architectural education

Architectural education is not left out of these changes. Nowadays, there is a broad academic consensus on the need to adapt existing educational models to contemporary professional trends in order to offer a more appropriate education to students.[9] Some of the topics of current debate are: the question of whether students should receive more specialized training or more general and transversal education; the transition from a content-centered learning to another based on processes and competences; the importance of innovation in academic programmes; the impact of the digitalization of knowledge or the approach of students to the social and professional reality.

During the last decade, schools of architecture have begun to examine their pedagogical models to develop and apply alternative teaching and learning methods that enable them to go beyond their established curricula. Academia must completely revisit the current curricula and imagine a system that acknowledges the obsolescence of how and what is taught in today' schools of architecture.[10] It is their duty to properly adapt their curricula to turn their students into capable professionals and to bridge the gap between academia and practice.

Yet how can this be achieved? Today, the Design Studio still lies at the core of architectural education.[11] It can be described as a face-to-face learning space where the knowledge is obtained through a process of creating a product design (an object, a building or a city). The challenge of schools would be to reformulate the educational model of the Design Studio to overcome its pedagogical limitations and to reform the way architects are trained as professionals. Thus, the Design Studio would be evolving into new types of physical and virtual learning spaces with a direct relationship with the profession, a more active participation outside the academic environment, and an intensive use of digital technologies.

DISCLOSING THE DESIGN STUDIO

The educational model of the Design Studio has played a fundamental role in architects' training since the eighteenth century when, for the first time in history, the teaching of architecture was regularized in the French academic institutions.[12] This model has been redefined over time to adjust to social, cultural, economic and productive circumstances leading to the creation of other versions.[13] However, despite the methodological changes made to the original model, its basic structure has remained unchanged over the course of years: teachers introduce a hypothetical problem related to the practice and students work on its development in a physical environment of low risk.

Characteristics

Leaving aside its infinite applications, the Design Studio can be defined as a constructive, social and reflective learning space in the intersection between the academic and the professional field (Figure

1). It is a model of reality where a professional situation is reproduced in an academic context to teach students the knowledge required to work professionally in architectural studios. In this sense, the Design Studio is conceived as a reflective practicum: a virtual world which seeks to represent essential features of the practice that must be learned while student are offered the opportunity to apply them in the studios.[14] Thus, the simulation of the professional practice has one goal: students must understand how the profession works by solving different professional problems (Problem-Based Learning) with the help of an expert who encourage them to become autonomous thinkers. Typically, the learning processes occur when students develop a project in its stages (Project-Based Learning): identification of the problem, information gathering, proposal development, discussion and presentation. In each of these steps, students build up their own knowledge through an active process of interpretation, questioning and experimentation.[15] This process usually takes place in a physical space within the school. The studio-class is a multipurpose open space which serves to support various learning activities (conferences, lectures, informal talks and formal reviews) and to promote different patterns of interaction.
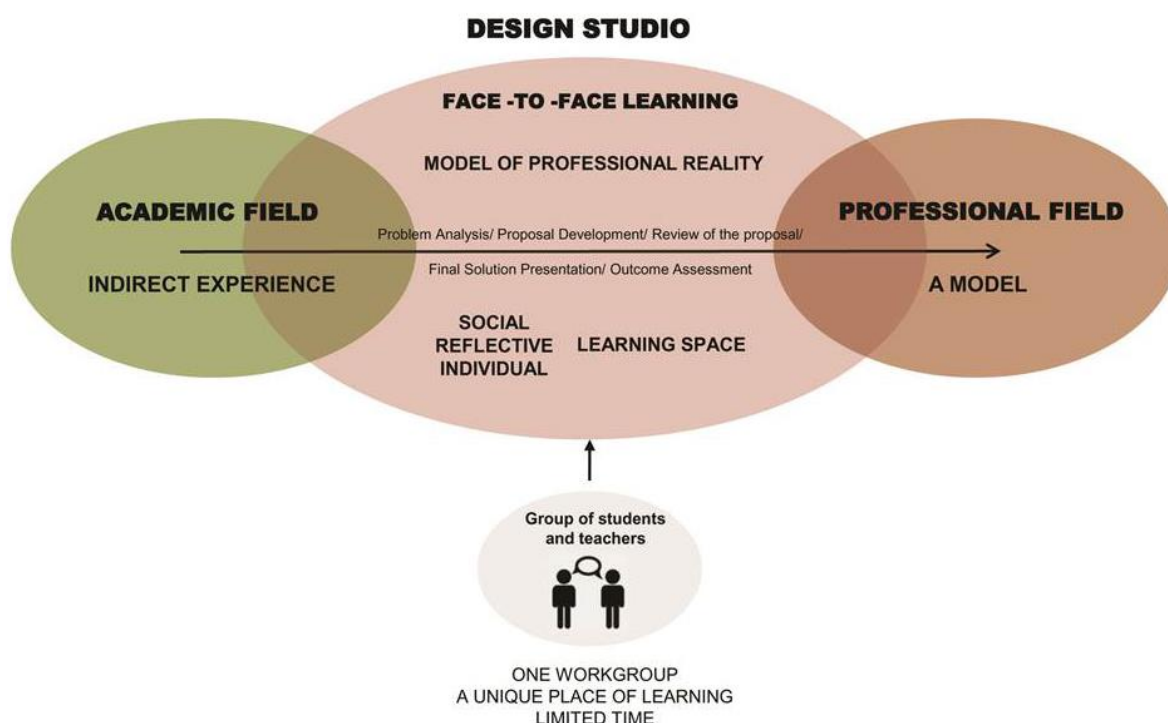
Figure 1. The current design studio model

Limitations

Nowadays, the Design Studio presents certain pedagogical limitations which directly affect the student training. Its purely methodological characteristics have remained unchanged regardless of their concrete implementation in a specific place and time. This is the prime reason why the educational model of the Design Studio has grown more and more distant from the professional trends in this last decade. Among the most prominent constraints, we can cite:

- There is no direct link with the profession because relevant issues related to the management, cost and marketing are omitted. The learning tasks are generally focused on solving hypothetical problems instead of articulating real and pragmatic architectural problems.[16]
- The students' learning is limited by the physical environment. Students are subjected to

isolation (in the physical sense but also in the formative sense) because they spend most of their learning time interacting only with other students and teachers at school. [17] The Design Studio becomes their social and educational centre due to the fact that all learning activities are organized around this physical space. Thus, student relations with the outside world are secondary and sporadic.

- The hidden curriculum accentuates social inequalities and prevents students from becoming independent. The social structure of the studio, the teachers' authority, the way of speaking and dressing, the readings and the references to specific architects function as means of "culturization".[18] All these elements can create a partial and unidirectional vision of architecture and affect the students' creativity and personality.

- The design process is developed mostly individually, and the results are valued for their uniqueness evoking the outdated idea of the architect as a celebrity. This generates a competitive working environment distant from reality. It also becomes a private and shameful act for students, in which not knowing the right answer is an admission of failure rather than opportunity for creativity.[19]

- The interventions of the teachers become a barrier to the students' learning. They tend to impose (consciously or unconsciously) their standards and to legitimize their power. Through this authoritarian discourse, students gradually lose their confidence and the communication between both parts fails.[20]

BLENDING ACADEMIA AND PRACTICE

During the last five years, several publications have appeared in the academic field referring to the idea of developing new teaching strategies in order to provide a better education. [21] One of these approaches is the integration of other educational models in the Design Studio. Some of these models which are postulated as the most appropriate to update the traditional concept of the Design Studio are: Distance Learning, Blended Learning, Problem-Based Learning and Work-Based Learning.[22]

In the case of Work-Based Learning (WBL), this model has the potential to fundamentally transform the way in which architectural education engages issues of professional expertise and suggests opportunities to question the rules of the traditional instruction. The WBL is seen as facilitating forms of learning and types of knowledge which are of particular relevance to the work in which the learners are engaged.[23] It is also associated with two quite different purposes. The first is the development of the enterprise through contributing to production, effectiveness and innovation. The second is the development of individuals through contributing to knowledge, skills and the capacity to further their own learning.[24]

An Alternative Model

When the WBL is integrated in the current educational model of the Design Studio, a relevant change occurs (Figure 2). The Design Studio is not any more a learning space in the intersection between the academic and the professional field. Practice and education become coincident and complementary because this new model combines the formal teaching that takes place in the studios of the school with informal, organizational and lifelong learning that happens in engineering companies and architectural studios. It also transforms the Design Studio into a more socially, accountable and reflexive learning space where students can develop their identity as professionals exploring different forms of professional practice in a supportive environment. In other words, the main contribution to the Design Studio is that professional practice is no longer simulated. Students can join forces with different specialists in diverse professional work environments outside the school. Therefore,

problems are no longer set and solved in a context governed by the interests of a specific academic community, but they are carried out in a wider context of application.
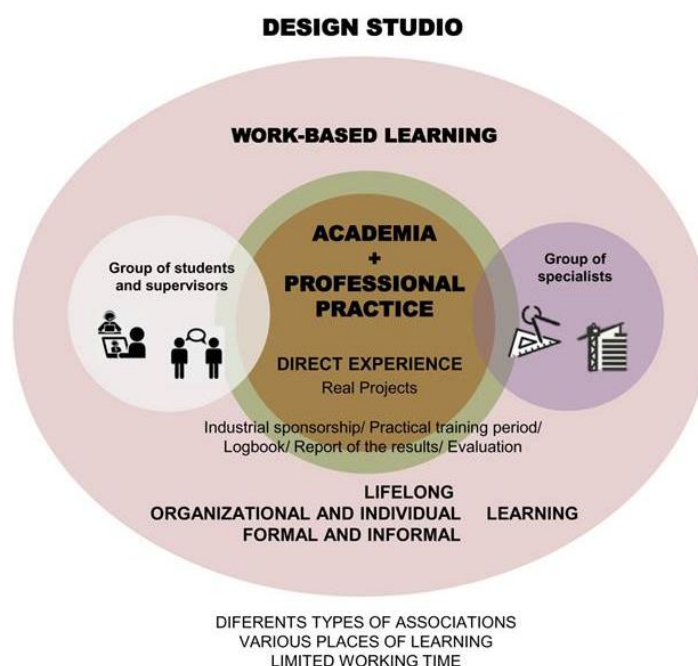
Figure 2. Transformation of the design studio model

Integrating Work-Based Learning into the Design Studio

There are two ways to incorporate the WBL into the Design Studio. First, it can maintain the essential characteristics while it builds connections with the architecture, engineering and construction sector. Second, it can transform radically the Design Studio into an experimental and hybrid learning space. Both tactics provide different learning and teaching tools which can help to upgrade the current educational model of the Design Studio.

The first way could be related with the student's year-out training experience in architectural offices. Some countries (especially in Europe) focus on the transition between academia and practice in terms of how students learn and work in their year-out training period. Typically, the route to qualifying as an architect is a combination of academic studies and practical experience. It is intended that schools develop courses pursuing distinctive interpretations of the practical and theoretical skills needed by architects to occupy increasingly diverse roles and to work in a global economy.[25]

If you examine this option in detail, it appears that the students' training experience is not unified. There is not a true integration of knowledge acquired in both architectural offices and design studios. A first impression is that they may be reinforcing to each other, but they have different goals and are directed towards different ends. Whereas work is headed to produce what architectural studios are in the business of offering, learning is interested in the acquisition of knowledge and the capacity to achieve further expertise.[26] The result is that this hybrid training structure relates the Design Studio with a much older tradition of separating theory from its practical application.[27] Thus, the apprenticeship model, originated in the nineteenth century, has been almost literally transferred into an educational setting.[28] This divergence is indeed a problem. Academics and professionals must work together to find a solution.

A possible path could be to establish more productive alliances for both parties and blend theory and

practice in a single learning space. The Loughborough University (England) is an example.[29] The university in collaboration with a group of several companies created a design studio on construction management in 2005.[30] The consortium hoped to establish a society that, without the need to limit the academic activity and combining different types of instruction, would build strong links to help students to achieve real professional expertise and companies to get qualified staff. The cooperation between both parts was a sponsorship agreement. All the projects were supported by real case studies and supervised by specialists. In addition, the content was completed by other academic programmes causing interdepartmental collaborations.

The second way is that the WBL can be used to combine professional practice with education and academic research. Currently, the trend is the organization of design studios based on the resolution of real projects involving international students, teachers, professionals and researchers. In these design studios, the act of learning is linked to research and it can occur in any context. The implication is that the nature of these learning spaces becomes more experimental and open. It is also important to note that they are inspired by the principle of entrepreneurship.[31]

For instance, the Technical University of Berlin and the LIN French studio have created the LIA laboratory where architects, students, researchers and professionals work together in the development of real projects.[32] The particularity of this lab lies in the ability to unite profession and education through the act of research. In this case, the research is used as a means to address the problems of a project from different professional and academic points of view. This serves to continually reevaluate the studio's professional practice and to create architectural innovation in an academic environment.

In a similar way, the students of the Institute for Advanced Architecture of Catalonia designed and built a housing prototype for the European Solar Decathlon Competition in 2010.[33] The work was carried out with other universities and professional companies. Students had the opportunity to get exposure to a different educational experience that allow them to learn first-hand about how architects work in international and multidisciplinary teams, how a project of this scale is developed using new digital technologies and how the design and construction phases are integrated in a real project.

CONCLUSION

At present, a greater integration of the WBL in the Design Studio as a transformative factor would make sense for several reasons. The first cause is the challenge to bring students closer to the professional reality and take them out of a controlled educational environment. In this context, the WBL can provide the pedagogical tools to blend a practical instruction in diverse workplaces with more conventional studies in the school. It can also offer flexible and personalized training from the first year of the degree to the last. Students, guided by teachers, can choose where, when and with whom they want to carry out their learning. In addition, it can support students with enough freedom to take decisions about how to proceed in their training and define a route that will allow them to achieve their own professional goals and gradually incorporate into their future work environments.

The second cause is the current need of engineering and architectural studios to find specialists with specific professional competences. This type of Design Studio would allow the establishment of academic and professional coalitions to respond to the contemporary professional trends. There is, however, a problem to be considered. Some authors oppose this approach because they consider that the true motivation of this process is exclusively economic.[34] In some cases the students' training is tailored to meet market demand. This business direction does not consider learning as a value in itself (from a more humanistic and social perspective), but it puts the university at the service of economic interests. Yet this can be a good opportunity for schools of architecture. If instead of fitting the

teaching with the professional requests, they propose mutual reciprocity actions and try to respond to today's social (not economic needs), they can offer a quality education.

The third cause is the goal of promoting research in academia linked to a practical and real purpose. This is a recent trend which conceives the Design Studio as interconnected, interdisciplinary and experimental learning spaces. The Design Studio becomes a cross-learning space (physical and virtual) where different areas of architectural knowledge are integrated simultaneously. Generally, a mixed international team (formed by professionals and learners) have to develop a real project using innovative technological and trial methods. In this environment, students can reconnect the information acquired in separate courses and turn it into applicable knowledge in their own work. This implies a change in the students' work methodology but, at the same time, improve their capacity to learn.

In summary, the WBL can aid to rethink and modernize the current model of the Design Studio introducing new educational formulas from other fields. Some aspects of its implementation in the teaching of architecture are more consolidated than others. However, as the Design Studio evolution process continues, it is reasonable to assume that in the next years its relationship with the WBL will also advance. For now, it seems that a potential path could focus on a model where students have to acquire the ability to be more critical, curious and autonomous through research-based learning activities designed by teachers and professionals.

NOTES

[1] This paper is part of our doctoral thesis *La transformación del Taller de Arquitectura en nuevos espacios de aprendizaje. Un estudio sobre el proceso de integración entre la enseñanza y la práctica profesional* (presented at the University of Girona, Girona, Catalonia, December 12, 2017). In the first chapter, this research studies how the teaching and practice of architecture have been reformulated throughout history depending on social, cultural, technological and productive circumstances. It also illustrates that there have been three relevant moments in history that have determined the bonds between both fields. The first moment occurs between Antiquity and the Middle Ages. During this historical period the learning and practice take place simultaneously in the construction stage in a trial and error process. The second moment happens in the Renaissance. The learning and practice are carried out separately in the design and construction stages. For the first time in history, the conception phase (creation and representation of the idea) and the execution phase (realization of the idea) are seen as two independent entities. Finally, the third moment takes place between the eighteenth and twentieth centuries. The systematization of the architect's training and the professionalization of the architectural exercise entail the definition of the academic and the professional field. See: https://tesisenred.net/handle/10803/482043.

[2] For further information on the changes that the profession is currently experiencing, see the annual reports issued by the following organizations: Royal Institute of British Architects (RIBA), American Institute of Architects (AIA), Union International des Architects (UIA), Consejo Superior de los Colegios de Arquitectos de España (CSCAE) and Architects' Council of Europe (ACE). The most prominent reports are: Col·legi Oficial d'Arquitectes de Catalunya, eds., *L'exercici de l'arquitectura al món* (Barcelona: CG Anmar S.L., 2005), accessed July 30, 2019, https://www.coac.net/internacional/cat/eamindex.php; Centro de Estudios de la Profesión de Arquitecto, eds., *Informe sobre el estado de la profesión 2009* (Madrid: Consejo Superior de los Colegios de Arquitectos de España y Caja de Arquitectos, 2009), accessed July 30, 2019, https://fundacion.arquia.es/media/encuestas/downloads/informes/informe_encuesta_profesionales_2009.pdf; Dickon Robinson, Claire Jamieson, John Worthington and Caroline Cole, *The Future for Architects?* (London: RIBA, 2012), accessed July 30, 2019, https://www.researchgate.net/publication/240916942_The_future_for_Architects; Fundación Arquia, eds., *IV Encuesta on-line a arquitectos* (Barcelona: Fundación Arquia, 2014), accessed July 30, 2019, http://fundacion.arquia.es/media/encuestas/downloads/informes/informe_encuesta_profesionales_2014.pdf; UIA, eds., *UIA Accord on Recommended International Standards of Professionalism in Architectural Practice* (Paris: Union International des Architects, 2014), accessed July 30, 2019, https://www.bak.de/w/files/bak/02architekten/05internationales/1454321930v4bbw8wd2dq42ph7.pdf; AIA, eds., *Diversity in the Profession of Architecture* (Washington: The American Institute of Architects, 2015), accessed August 2, 2019, http://www.architectural record.com/ext/resources/news/2016/03-Mar/AIA-Diversity-Survey/AIA-Diversity-Architecture-Survey-02.pdf.

The communications of these international conferences can also be useful: the ACSA International Conference *Change, Architecture, Education and Practice*, Association of Collegiate Schools of Architecture, Barcelona, Spain, June 20-22, 2012; the *7th Annual International Conference on Architecture*, Athens Institute for Education and Research, Athens, Greece, July 3-6, 2017.

[3] For additional details on how engineering and architectural studios are adopting new methods of collaborative and interdisciplinary work, see: Andrew Pressman, *Professional Practice 101. Business Strategies and Case Studies in Architecture* (New Jersey: John Wiley & Sons, Inc., 2006); George Elvin, *Integrated Practice in Architecture. Mastering Design-Build, Fast-Track, and Building Information Modeling* (New Jersey: John Wiley & Sons Inc., 2007).

[4] Nowadays, engineering and architectural studios are not only using the Internet and social media to exchange and disseminate architectural information worldwide, but also to encourage the direct involvement of citizens in major social and urban issues on global scale. RaumLabor in Germany (accessed August 7, 2019, http://raumlabor.net/); Arquitectura Expandida in Colombia (accessed August 7, 2019, http://arquitectura expandida.org/) and Arquitecturas Colectivas in Spain (accessed August 7, 2019, https://arquitecturas colectivas.net/) represent diverse examples of how professionals are employing these technology to work online temporarily in horizontal organizational structures and to conduct long-term participatory actions.

[5] In these books, the authors examine the methods that engineering and architectural studios are using to implement innovative design and construction procedures through digital technologies: Stephen Kieran and James Timberlake, *Refabricating Architecture. How Manufacturing Methodologies are poised to Transform Building Construction* (New York: McGraw-Hill, 2004); Charles Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston, *BIM Handbook: a Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors* (New Jersey: John Wiley & Sons, 2008); Randy Deutsch, *Bim and Integrated Design. Strategies for Architectural Practice* (New Jersey: John Wiley & Sons, Inc., 2011); Hanif Kara and Andreas

Georgoulias, eds., *Interdisciplinary Design. New Lessons from Architecture and Engineering* (New York: ACTAR Publishers, 2012).

[6] Some interesting participatory models whose proposals have encouraged citizen collaboration, assembly pluralism and low cost architecture are: the regeneration of the NDSM pier (Amsterdam) and the temporary occupation of the Sphinxpark (Maastricht) in Holland cited by Sergio Martín Blas, "Una emergente 'clase creativa' ocupa los espacios urbanos sin uso", *El País*, October 16, 2013, Sección de Economía, Edición Digital, http://economia.elpais.com/economia/2013/10/15/vivienda/1381822988_915274.html. In Spain, there are the urban project of Campo de Cebada in Madrid (accessed August 8, 2019, https://es.wikipedia.org/wiki/Campo_de_

Cebada) and the neighbourhood self-management plan of Can Batlló in Barcelona (accessed August 8, 2019, https://www.canbatllo.org/). In addition, it is important to underline that the actors who participate in these social projects form a heterogeneous group of specialists and clients. They work together from the conception phase of the project to its execution and post-occupation. The professionals who cooperate with the architect are not only specialists from the architecture sector, but they are also experts from other disciplines such as social sciences, humanities, pedagogy, arts and natural sciences. For more details, see: Consejo Superior de los Colegios de Arquitectos de España and Fundación Caja de Arquitectos, eds., *Informe Arquitectos 2007. Encuesta sobre el estado de la profesión* (Madrid: Consejo Superior de los Colegios de Arquitectos de España and Fundación Caja de Arquitectos, 2007),accessed August 2, 2019, https://fundacion.arquia.es/media/encuestas/downloads/informes

/informe_encuesta_profesionales_2007.pdf; Robinson et al., *The Future for Architects?*; Anatxu Zabalbeascoa, "Otros cimientos para la arquitectura", *El País*, February 25, 2014, Sección Cultura, Edición Digital, http://cultura.elpais.com/cultura/2014/02/24/actualidad/1393272950_394402.html.

[7] For more clarification on the changes that women architects are introducing in the practice of architecture and to know their perception of gender space architecture, see: Iain Borden, Barbara Penner and Jane Rendell, *Gender Space Architecture: An Interdisciplinary Introduction* (United Kingdom: Routledge, 2002); Núria Álvarez Lombardero, eds., *Arquitectas, redefiniendo la profesión* (Sevilla: Recolectores Urbanos Editorial, 2015), Despina Stratigakos, *Where are the women architects?* (New Jersey: Princenton Univeristy Press, 2016); Zaida Muixí Martínez, *Mujeres, casas y ciudades. Más allá del Umbral* (Barcelona: dpr-barcelona, 2018). The communications of the International Conference *MORE: Expanding Architecture from a Gender-Based Perspective*, UniFi-School of Architecture, Florence, Italy, January 26-28, 2017) can also be valuable to increase knowledge in this area.

[8] At present, the most prominent professional profiles in architecture are: project manager, BIM manager, 3D designer, real estate asset analyst, mediator, environmental consultant, facility manager, programmer, energy efficiency analyst and retailer. See also: Rory Hyde, *Future Practice. Conversations from the Edge of Architecture* (New York and London: Routledge, 2012).

[9] In the last two decades several studies have focused on design studio teaching and its potential to enhance attitudes and skills in order to prepare students for a future profession. These documents have helped to consolidate the idea that today architectural education has to reformulate its pedagogical values. See: Ernest L. Boyer and Lee D. Mitgang, *Building Community: A New Future for Architectural Education and Practice* (Princeton: The Carnegie Foundation for the Advancement of Teaching, 1996); David Nicol and Simon Pilling, eds., *Changing Architectural Education. Towards a New Professionalism* (London: Taylor and Francis Group, 2000); Ashraf M. Salama, William O'Reilly and Kaj Noschis, eds., *Architectural Education Today: Cross Cultural Perspectives* (Lausanne: Comportements, 2002); Michael Chadwick, eds., *Back to School: Architectural Education -The Information and The Argument* (London: Wiley-Academy, 2004); Ashraf M. Salama and Nicholas Wilkinson, eds., *Design Studio Pedagogy: Horizons for the Future* (The United Kingdom: The Urban International Press, 2007). In the following conferences, the same topic was also discussed internationally: the EAAE International Conference and Workshop on Architectural Education *Educating the Future: Architectural Education in International Perspective*, Istanbul Kultur University and European Association for Architectural Education, Istanbul, Turkey, March 21-23, 2013; the AAE International Conference on *Architectural Education (un)common currency*, Nottingham Trent University and Association of Architectural Educators, Nottingham, England, April 03-05, 2013.

[10] Michael A. Ambrose, "BIM and Integrated Practice as Provocateurs of Design Education" (paper presented at the 12th International Conference on Computer Aided Architectural Design Research in Asia, Nanjing, China April 19-21, 2007), 284.

[11] Ashraf M. Salama has been over three decades one of the authors who has studied more extensively the evolutionary nature of design pedagogy and its contemporary condition. The first time he mentions the relevance

of the Design Studio as a paradigm of teaching in architecture is in 1995. See: Ashraf M. Salama, *New Trends in Architectural Education. Designing the Design Studio* (North Carolina: Tailored Text, 1995).

[12] The origin of the Design Studio can be traced to the eighteenth and nineteenth centuries. It was during this period when art academies and polytechnic schools created the Modèle Polytechnique and the Modèle Industriel to educate future architects and engineers. Both models blended theoretical instruction (sciences pures) taught by academics (académiciens) at the amphitheater (amphitéatre) with practical learning (sciences appliquées) in the ateliers under the supervision of a famous architect (the patron). The ateliers system was the core of the curriculum of these institutions. Its main features were: an evaluation system based on competitions (concours); the construction of knowledge through a critical reflection between the architect (patron) and students (élèves); and the practical application of theoretical concepts in the ateliers by solving hypothetical design projects. These pedagogical features would become the heart of the Design Studio. For more information, see: Ulrich Pfammatter, *The Making of the Modern Architect and Engineer. The Origins and Development of a Scientific and Industrially Oriented Education* (Basel: Birkhäuser, 2000).

[13] In the twentieth century, although the Design Studio remained a central component in the training of architects, different academic institutions introduced changes to the original model. However, despite these methodological adjustments, the basic characteristics of the Design Studio have apparently persisted until today. This topic is discussed in the first chapter of our thesis *La transformación del Taller de Arquitectura en nuevos espacios de aprendizaje* where several important institutions of the twentieth century (the Bauhaus, the Ulm School of Design, the Texas School of Architecture and the Cooper Union) and their educational models has been studied in order to show the scope of these modifications.

[14] Donald Schön, *La formación de profesionales reflexivos. Hacia un nuevo diseño de la enseñanza y el aprendizaje en las profesiones* (Barcelona: Paidós, 2010), 156. Original version: id., *Educating the Reflective Practitioner* (San Francisco: Jossey-Bass Publishers, 1987).

[15] Patience Lamunu Opiyo Lueth, *The Architectural Design Studio as a Learning Environment: A Qualitative Exploration of Architecture Design Student Learning Experiences in Design Studios from First-through Fourth-year* (Iowa: Iowa State University, 2008), 169.

[16] 2+ This point is reiterated in Beatriz C. Maturana, "Where is the 'Problem' in Design Studio: Purpose and Significance of the Design Task", *ArchNet-IJAR: International Journal of Architectural Research* 8, 3 (2014).

[17] For more clarification on the topic see: Kathryn H. Anthony, *Design Juries on Trial. The Renaissance of the Design Studio* (New York: Van Nostrand Reinhold, 1991); Dana Cuff, *Architecture: the Story of Practice* (Massachusetts: MIT Press, 1992); Aaron Koch, Katherine Schwennsen, Thomas A. Dutton and Deanna Smith, *The Redesign of Studio Culture. A Report of the AIAS Studio Culture Task Force* (New York: The American Institute of Architecture Students INC, 2002).

[18] This point is questioned in Helen Webster, "The Architectural Review. A Study of Ritual, Acculturation and Reproduction in Architectural Education", *Arts and Humanities in Higher Education* 4, 3 (2005): 265-282.

[19] Hayley Chivers, "Practices Makes Perfect", in *Radical Pedagogies. Architectural Education and the British Tradition*, ed. Daisy Froud and Harriet Harriss (London: RIBA Enterprises Ltd., 2015), 76.

[20] These two authors have reached similar conclusions: Thomas A. Dutton, "Design and Studio Pedagogy", *Journal of Architectural Education* 41, 1 (1987): 18; Ira Shor, *Empowering Education: Critical Teaching for Social Change* (Chicago: The University of Chicago Press, 1992), 93.

[21] The following publications can help build a more complete vision on today's architectural education and design studio teaching. They present different innovative educational cases and diverse reflections on academic trends. See: Graham Cairns, eds., *Design for a Complex World. Challenges in Practice and Education* (Oxfordshire: Libri Publishing Ltd., 2014); Ashraf M. Salama, *Spatial Design Education. New Directions for Pedagogy in Architecture and Beyond* (England: Ashgate Publishing Limited, 2015); Daisy Froud and Harriet Harriss, eds., *Radical Pedagogies. Architectural Education and the British Tradition* (London: RIBA Enterprises Ltd., 2015); Vera Kaps and Peter Staub, eds. *New Schools of Thought. Augmenting the Field of Architectural Education* (Zurich: Triest Verlag für Architektur, 2018). Another important source of consultation is: the International Conference *Education, Design and Practice. Understanding Skills in a Complex World*, Stevens Institute of Technology and AMPS, New Jersey, United States, June 17-19, 2019.

[22] These four models are studied in detail in the second chapter of our thesis *La transformación del Taller de Arquitectura en nuevos espacios de aprendizaje*. The research examines their pedagogical characteristics and their implementation in the current model of the Design Studio. In particular, it focuses on how the teaching and learning processes, the place and time, the role of the teachers and students, the information management and the construction of knowledge are being reformulated.

[23] Fiona Reeve and Jim Gallacher, "How are the Discourses of Work-based Learning Influencing Practice?" (paper presented at the Conference Proceedings, Researching Work and Learning: A First International Conference, England, University of Leeds, 10-12 September, 1999), 125, accessed August 12, 2019, https://www.voced.edu.au/content/ngv%3A18856

[24] David Boud and John Garrick, "Understanding of Workplace Learning", in *Understanding Learning at Work,* ed. David Boud and John Garrick (London: Routledge, 1987), 6.

[25] The following British reports, among others, are an illustrative example of this method: RIBA, *RIBA Procedures for Validation Criteria for UK and International Courses and Examinations in Architecture* (London: RIBA, 2014 Second revision), accessed August 14, 2019, https://www.architecture.com/-/media/gathercontent/validation-procedures-and-criteria/additional-documents/validationprocedures2011secondrevision2may2014pdf.pdf; "Becoming and Architect", RIBA, accessed August 14, 2019, https://www.architecture.com/education-cpd-and-careers/how-to-become-an-architect

[26] David Boud, "Knowledge at Work: Issues of Learning", in *Work-Based Learning: A New Higher Education?*, ed. David Boud and Nicky Solomon (Buckingham: SHRE and Open University Press, 2001), 34.

[27] Kevin Orr and Yun Gao, "Becoming an Architect: the Role of Work-Based Learning in Architect Training" (paper presented at the 7th International Conference on Researching Work and Learning, East China Normal University, Shanghai, China, December 4-7, 2011), 5, accessed August 14, 2019,https://www.academia.edu/29807398/Beco

ming_an_architect_the_role_of_work_based_learning_in_architect_training. See also: Yun Gao and Kevin Orr, "Architectural students' year-out training experience in architectural offices in the UK", *arq* 19, 2 (2015): 175-182, accessed August 14, 2019, doi.org/10.1017/S1359135515000391

[28] Helen Webster, "Architectural Education after Schön: Cracks, Blurs Boundaries and Beyond", *Journal for Education in the Built Environment* 13, 2 (2008): 64, accessed August 14, 2019, doi.org/10.11120/jebe.2008.0302

0063.

[29] The following case studies are a representative compilation of how the integration of the Work-Based Learning into the Design Studio can transform the design teaching. Obviously, there are more cases that can be studied and discussed in a more extensive document. For more details of these cases and others, see our thesis *La transformación del Taller de Arquitectura en nuevos espacios de aprendizaje*.

[30] Alistair Gibb, "Construction Engineering Management: Academic Collaboration with Industry", *CEBE Transactions* 2, 1 (2005): 18.

[31] Enterpreneurship has been described as the capacity and willingness to develop, organize and manage a business venture along with any of its risks in order to make a profit (accessed 15, 2019, https://en.wikipedia.org/ wiki/Entrepreneurship). This document presents a new Design Studio where Work-Based Learning can provide the necessary tools and connections to turn students into entrepreneurs. In other words, the design studio would become a learning space where students and teachers are dedicated to identify and develop potential architectural challenges and exploit them as an academic and professional opportunity. Therefore, students would not only perform theoretical exercises in the design studio but their ideas/projects would lead to a practical application in the professional and social field with possible economic benefits.

[32] The following websites contain more material on this case: "Official Website", LIN Office, accessed August 11, 2019, https://www.lin-a.com/office and "Official Website", LIA Laboratory, accessed August 11, 2019, http://www.lia.tu-berlin.de/.

[33] See this blog to learn more about this case: "FabLab House", IaaC, accessed August 11, 2019, http://www.fab labhouse.com/blog/.

[34] This approach is questioned in Agustín Moreno, Enrique J. Díez Gutiérrez, José Luís Pazos and Miguel Recio, *Qué hacemos con la educación* (Madrid: Akal, 2012); Enrique J. Díez Gutiérrez, Adoración Guamán, Josep Ferrer Llop and Ana Jorge Alonso. *Qué hacemos con la Universidad* (Madrid: Akal, 2014); Joel Spring, *Economization of Education: Human Capital, Global Corporations, Skills-Based Schooling* (United Kingdom: Routledge, 2015).

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THE VIRTUAL DESIGN STUDIO – THE DEVELOPMENT OF AN ONLINE PEER LEARNING STUDIO FOR SPATIAL DESIGN STUDENTS

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INTRODUCTION

In spatial design education, the nature of studio-based learning is inherently feedback-rich, due to is dialogic nature.[1] Schön regarded the conversational exchanges between tutor and student and student and student in formal and informal learning settings of high pedagogic value in design education.[2] The idea and culture of the studio underpin most design education and practice. It is a concept and context for working in design that is informal, motivating and supportive. A studio is an open environment where individuals or groups do visually centered work. It is a space that allows students to engage with and inspire each other beyond the parameters of formal classes, and where novice designers obtain knowledge and practices from their peers.[3] Design studio pedagogy is typically defined as "learning by doing", and the sessions are organized around project-based learning.[4] The projects are planned in manageable scales, individually or collectively, simulating actual practice as closely as possible. Spatial design studio learning embraces many forms of representations, including studio crits, formal and informal feedback, reflections on designing and access to industry representatives.[5] Since the mid-1990s, the studio learning experience has changed as a result of significantly reduced contact hours, larger student cohorts and a lack of designated studio space. Students no longer have dedicated space to learn in and, with a reduction of contact hours, studio culture has considerably changed its dialogic nature and hence the learning experience for visually centered work.

At Griffith University, formal direct student contact in a class environment was halved from seventy contact hours per semester in 2000 to thirty-six hours in 2019. Further, peer interactions and socialized learning outside the classroom have almost totally disappeared in the twenty-first century, due to the changing nature of tertiary educational practices in a dynamic market. Evidence suggests, however, that students in fields traditionally depending on studio-based pedagogy, struggle to master diverse skill sets, deal with confrontational formative feedback and heavy and often complex project workloads. There is not enough time in the classroom to actively engage with problems and learn through the sharing of ideas, discussing problems and prototyping. In addition, the lack of informal dedicated studio space, where a cohort stays on campus, working on projects and receiving informal feedback from peers and visiting academics on a regular basis that supports them in specific critical aspects of studio culture, has taken a toll on positive learning outcomes.[6]

The problem with the present studio learning techniques is that learners struggle to master varied skill sets quickly, cope with confrontational formative feedback and heavy and often complicated workloads. A recent Griffith University student survey revealed that students want to feel engaged and connected with their peers, faculty staff, tutors and the place where they learn. Student engagement, first implemented in 1984 by Astin as student engagement, was originally described as "the quantity of physical and psychological energy devoted to educational practice by the student".[7] Since then, there has been much discussion about the significance of student involvement.[8] The Griffith Virtual Studio (GVS) resulted from research indicating that the essence of the design studio is translatable to online learning. The opensource Hypothes.is software, which acts as a text-based conversation layer using any website, enabled a quick and easy implementation of the GVS. Students were asked to sign up to Hypothes.is and join GVS and register a link to their blog. A pilot study over twelve weeks was then conducted with seventy final-year spatial design students in semester 1/2019. Comparing the reviews of the literature with the observations and survey results of this study, this paper argues that there is an urgent need to reintroduce a studio culture where a rich social dynamic, peer interactions and socialized learning can be developed.

The observations and results from an online survey will be discussed in the following chapters and provide important information to refine the GVS pilot study for future implementation.

THE GRIFFITH STUDIO

The Design of the Study

This study resulted from the reception of a modest teaching and learning grant to investigate the declining studio culture in the Griffith University spatial design major. A notable regression in the students' ability to meet learning objectives prompted the researcher to investigate the consequences of changing studio culture in spatial design education. Several factors were considered, including students' availability to stay and work on their projects on campus, the loss of physical studio space and the reduction of formal contact hours. The literature review indicated that some aspects of the design studio are, in fact, translatable to online learning. The pilot study involved the design of an online studio to encourage peer interaction in the form of various kinds of dialogue that typify studio-based learning, aiming to provide guidance, direction and reflection during the trial. The study also included a student survey conducted at the end of the trial phase. The study adopted an ethnographic approach, gathering data on student perceptions over the course of an academic semester, and utilizing methods embracing both quantitative and qualitative data.

The pilot study included the design and development of an online studio called the GVS, an online annotation platform for seventy final-year spatial design students over twelve weeks. The study involved the students creating their blog URL of choice and sharing it on Blackboard. The blogs contained their individual design processes of the term project. The students were also asked to sign up to the GVS using Hypothes.is, an open-source software which allowed the students to annotate their blogs collaboratively.[9] The students were also encouraged to comment on each other's progress throughout the semester, share resources and informally critique each other.

Objective

This project sought to analyze the effective use of the GVS for one semester, to draw conclusions that are of general relevance to spatial design educators. The findings will enable the future development and adoption of an approach that enables online informal course structure and delivery.

Population and Sampling

A pilot study involving seventy final-year spatial design students was conducted over twelve weeks, followed by a survey questionnaire that was administered to the participating students of the GVS to identify the best practices in design studio learning. The study monitored the use of the GVS and measured a possible increase in the academic quality and rigor in the students' project work.

The end of semester survey inquired about the success of using the GVS in a third-year design studio course based on the overall experience using the GVS in the following conditions: if the semester was a more engaging, interactive experience for students; if the online peer platform was perceived as having added value to formal studio learning; if it motivated students; if the support and feedback received by peers elevated their learning experience; and if the students would like to continue using it in a future course. The survey also aimed to verify information about teamwork and interdisciplinary activities. The survey was conducted among the spatial design students from four different classes located on two different campuses. A final-year spatial design studio was selected to ensure the highest probable results.

Methodology

Student interaction observations are the most common source of evidence used in evaluating participation. As such, the studio tutors were asked to promote student engagement, with particular mention of the online learning environment. The students were instructed during formal studio time in weeks two and three on how to successfully engage with the GVS, though they also received written step-by-step instructions on how to sign up as a member of the GVS (Figure 1). Formative assessments in weeks four and seven monitored their engagement with the online studio, and the tutors also conducted weekly spot checks. Different metrics were investigated as indicators of engagement with the virtual learning environment (VLE) in the design phase of the GVS. These included how student success in the VLE was related to the total number of notations, the distribution of notations over the twelve weeks, the total number of comments left by more than ten different peers and the quality of the written interaction. The observations were performed on seventy students during a twelve-week semester. In all, fifty-nine students, or 84% of students, participated at least once in the twelve weeks, though eleven students did not engage with the GVS at all. Two tutors and the course convenor were involved in observing and evaluating student engagement with the GVS. The design involved four phases:

1. Encouraging student participation in the GVS discussion forums by providing practice to improve familiarity with the technical aspects and social dimension of forums during the orientation period.
2. Associating a grade with discussion contributions.
3. Introducing the method of applying critical and thoughtful feedback that stimulates analytical thought for the blog user.
4. Tutors and course convenors becoming strategically involved in the forums – not overpowering but encouraging.
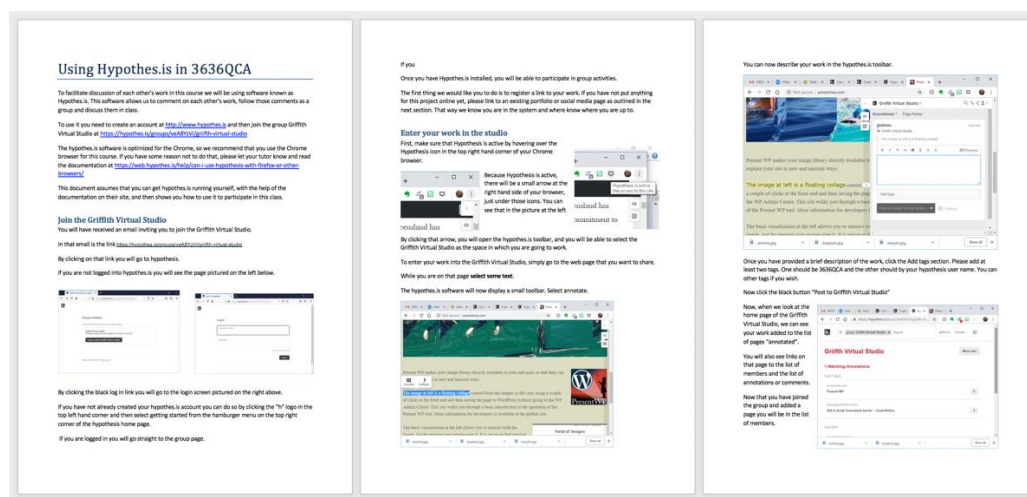
Figure 1. GVS student manual.

The survey, meanwhile, consisted of five main parts: personal information (optional), engagement with the study, engagement with peers during the twelve-week trial, learning experience in the GVS and management of the engagement with the GVS. Additional questions were asked about successful recording methods, as well as the significance of adding a virtual studio in addition to face-to-face studio contact. All the aforementioned questions were conditional for the future development of the GVS. The other conditional questions were for the methods of managing the online design studio, either for individual or group work.

The survey was administered online using Google Drive. A total of seventy invitations were sent to the students enrolled in the final-year spatial design course. Of them, thirty-seven students, or 51.4%, responded and answered the survey. The answers were evaluated for bias to guarantee the validity of the outcomes. Among the 46 answered forms, all were complete and presented valid responses.

SURVEY RESULTS

Figure 2 shows the respondent sample distributed according to campus. The respondents enrolled at the Gold Coast campus and Southbank campus comprised equal groups. Combined, 47.2% of participants indicated that they engaged weekly with the task, while only one student indicated daily engagement. Ten students (27.8%) had fortnightly interactions, eight students (22.2%) monthly and two students (15.5%) never engaged with the online studio at all (Figure 3).
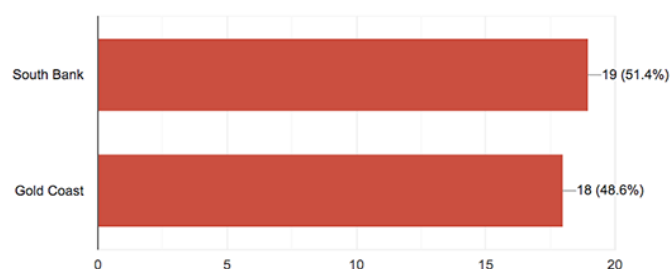
Figure 2. Survey question on campus attendance

2. How often did you engage with Hypothesis

37 responses
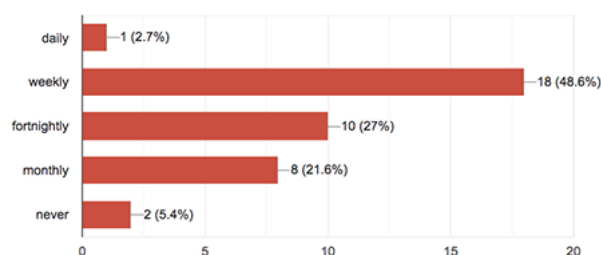
Figure 3. Survey question measuring the level of engagement

The Southbank group of respondents were the most active online. From the student cohort engaged on a daily or weekly basis, twelve students (66.6%) were Southbank students. There is perhaps a correlation between studio attendance, as 81.4% of the Southbank students attended more than 80% of classes, compared with 62% of Gold Coast students. The South Bank tutor was also more experienced, having worked in higher education for over a decade compared to the Gold Coast tutor, who was an experienced practitioner but had only been teaching for one year.

In total, 40.1% of the participating students scored the helpfulness in their learning with using the GVS at a six or higher, while 8.3% scored it at a five or undecided and 41.7% scored it below five, indicating that they did not see any or much value in participating in an online peer learning studio (Figure 4).

3. on a scale 1 to 10, indicate how helpful this learning resource was to you (1 not helpful and 10 extremely helpful)

37 responses
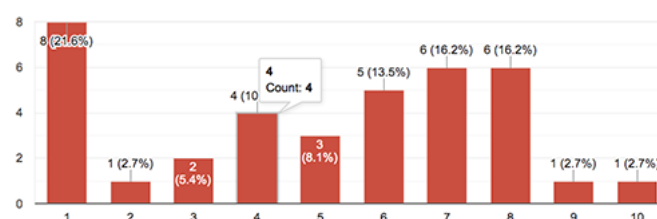
Figure 4. Survey Question indicating the usefulness of the learning resource

Additionally, 47.2% of students did not want to continue with the GVS, compared with 38.9% who were undecided and 13.9% who indicated that they would like for the GVS to be permanently implemented (Figure 5). Only 24.3% preferred an image-based platform, as opposed to 43.2% preferring the current setup, which is text-based. Meanwhile, 32.4% had no preference. This can perhaps be related to the cohort's general reluctance to visually communicate by sketching, drawing or illustrating, as they prefer to communicate ideas and design solutions in written and verbal forms. Most participants, or 52.8%, revealed that the comments received from their peers were unhelpful or

did not contribute to their learning. This compares to the 8.4% who said that the feedback given by their peers resulted in a direct improvement in their learning, as shown in Figure 6. This combination of respondents is considered an efficient survey sample.
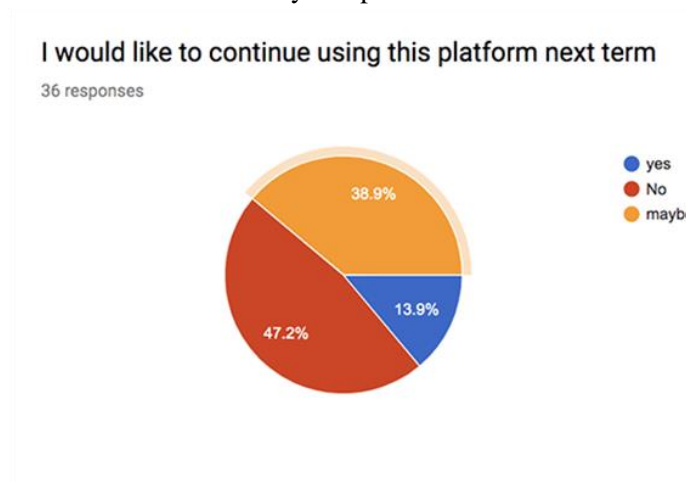
Figure 5. Survey question indicating preference for future use
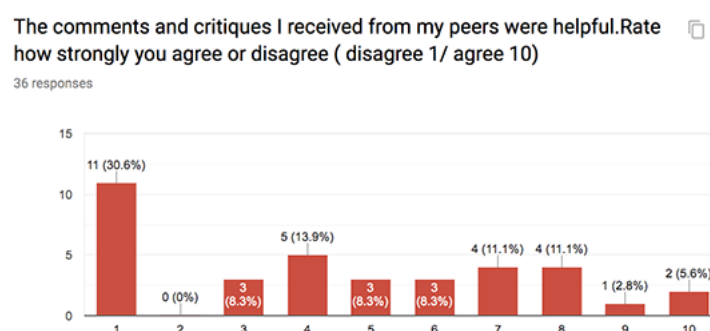
Figure 6. Survey question measuring the level of helpful peer interactions

The Results from the Observation of the GVS

Figure 7 shows a screenshot of a participating student's blogs. All students kept a daily blog documenting their design process.
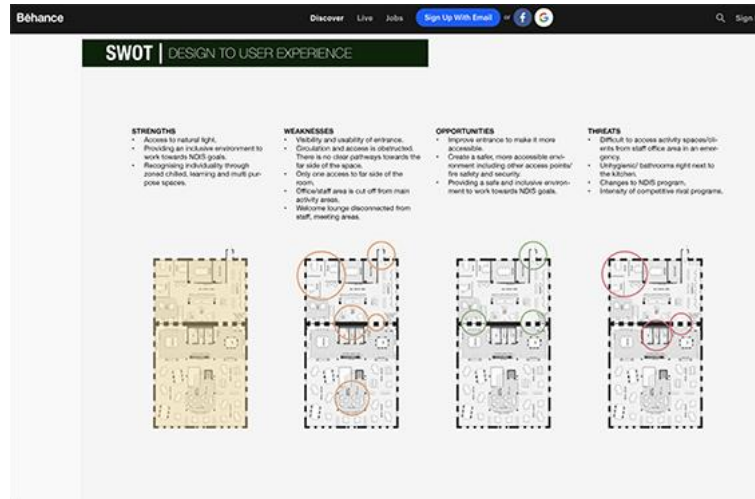
Figure 7. Typical entry in student project blog

Figures 8 and 9 show the comments left by participating students on another student's blog. The image shows a blog open in the GVS with comments.

Figure 8. Typical entry in student project blog with GVS comment section
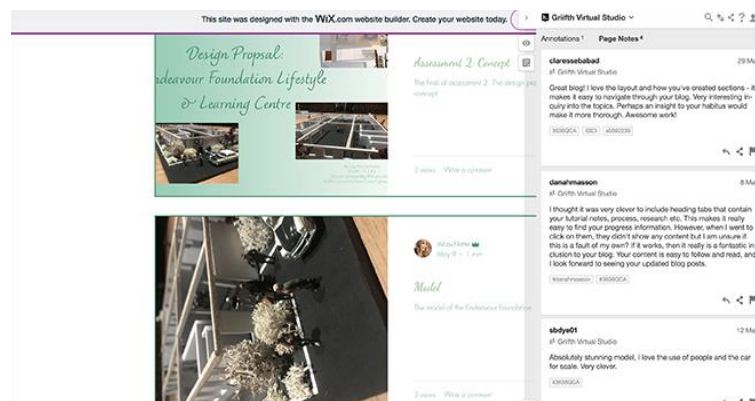
Figure 9. Typical entry in student project blog with GVS comment section

In comparison, Figure 10 shows a typical face-to-face classroom discussion during contact time with the participating cohort. As mentioned above, participation was low. In analysing the anonymous

student feedback within the course satisfaction surveys, three prevalent themes associated with non-participation and comment quality were identified:

1. Reticent student: The students indicated being reluctant to comment or critique their peers' work. They also mentioned that they were reluctant to share their own work with the cohort out of fear of being negatively critiqued or copied.
2. Student feedback that lacks depth: The participants commented on the unhelpful comments left by their peers. Some mentioned that they felt that most students only engaged with the study because it was assessed and did not critically engage with the work. Others thought that the feedback received was repetitive.
3. Added workload: Some students commented on the GVS as adding to their already heavy studio workload. Some argued that they all had work commitments outside university commitments and having to participate in a virtual classroom only added pressure. Others just could not see the relevance of it and thought it was a "waste of time". One student felt that the platform itself was time-consuming to navigate and questioned if there was perhaps a better way going forward.

Figure 10. Typical classroom studio discussion

SUMMARY AND RECOMMENDATIONS FOR FUTURE STUDIES

The present study aimed to evaluate the success of the Griffith Virtual Studio (GVS) by assessing the experience, use and results of learners. Universities are increasingly providing more "flexible" teaching environments with evolving student lifestyles and rapidly developing technology. Historically successful studio learning models, where students have a dedicated space to work, have been disappearing as a result of reduced contact hours, larger student cohorts and a lack of physical on-campus space. Although proven successful,[10] this traditional studio model has been transformed, due to the needs of flexibility and availability. The GVS tried to replace this space by introducing an online studio to final-year spatial design students, with the aim to help them construct and negotiate their own meaning and understanding of often complex concepts; create safe and supportive learning environments; and encourage interaction, engagement and self-directed learning.

Several themes emerged in the absence of involvement, the study overall and the quality of involvement, as discussed in the results chapter. The findings of the literature confirm that the underlying pedagogical value of informal and peer learning is essential for spatial design students, though the results suggest five main issues:

1. Time – Making the schedules flexible to accommodate working or parenting students.
2. A reluctance to share ideas and comments with peers – Consider making smaller peer groups and balancing strong and reticent students within these groups.
3. Unhelpful or shallow comments – Students need to learn the act of articulating a response which can lead to a meaningful discussion between peers and deepen learning through dialogue and meaningful exchanges.
4. Seeing the value of participation – Peer learning should be mutually helpful and require sharing between members of information, thoughts and experience. The tutor needs to reinforce this during face-to-face time with students. Reduce the number of participants and connect students who work well together. Develop management strategies to handle the groups. At the start of the studio, encourage teams to establish identities to form a rapport.
5. The design of the platform – Improve the sharing of information. Further research image-based vs. text-based platforms. Develop tools to allow a useful platform for design collaboration, including an audio link.

NOTES

[1] Donald Schön, *The Design Studio: An Exploration of Its Traditions and Potentials* (London: RIBA Publications Limited, 1985), ; Kathryn Anthony, (New York: Van Nostrand Reinhold, 1991), .

[2] Schön, *The Design Studio.*

[3] David Nicol and Simon Pilling, *Changing Architectural Education* (London: Taylor and Francis Publications, 2000).

[4] Dana Cuff, *Architecture: The Story of Practice* (Cambridge: MIT Press, 1991), .

[5] Ibid.

[6] Ibid; Nicol and Pilling, *Changing Architectural Education.*

[7] Alexander Astin, "Student Involvement: A Developmental Theory for Higher Education," *Journal of College Student Development* (1999): 518.

[8] Elisabeth Dunne and Owen Derfel, Introduction to *The Student Engagement Handbook: Practice in Higher Education*, by (Bingley: Emerald Group Publishing, 2013).

[9] "Hypothesis," Dan Whaley, accessed June 3, 2019, https://web.hypothes.is.

[10] Schön, *The Design Studio*, ; Nicol and Pilling, *Changing Architectural Education*, .

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CONTEMPORARY ARCHITECTURAL DESIGN AND WORLD HERITAGE CONSERVATION: TEACHING NEW APPROACHES FOR THE RECONCILIATION OF PRACTICES

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INTRODUCTION

The topic of this paper is the conservation of architectural and urban heritage and how it can be taught to students of architecture. It is part of my ongoing reflection about heritage conservation education in Canada in general and at the Université de Montréal's Faculty of Environmental Design and its School of Architecture in particular[1]. It is my contention that heritage conservation (or historic preservation as it is called in the United States) is an invaluable component of the skill set for architects who design, despite the fact that the two terms – design and conservation – are viewed as opposites in most architects' minds. Strangely, this dichotomy is relatively recent, dating back to the advent of modernism in architecture during the period between the two world wars. We often forget that in an earlier era, during the Industrial Revolution, the plethora of styles developed under Historicism represented the very essence of contemporary architecture. Famous architects such as Eugène-Emmanuel Viollet-le-Duc and George Gilbert Scott pursued careers that consisted of both restoration of monuments and design of new construction. The rejection of any references to history in architecture by the pioneers of modern design marks the opening of the chasm between what are now considered two different types of practice. In light of current issues about the built environment like climate change, waste management and the dramatic increase in urban population, can the contemporary practice of architecture and that of heritage conservation still afford to view the world in such a binary fashion? Are there no common goals to be identified and pursued jointly? I believe so. Schools of architecture play a determinant role in the evolution of these perceptions.

This text is divided into three parts. The first provides background information about education in heritage conservation at the Université de Montréal's School of Architecture. An outline of the educational program for students of architecture put together by the author that brings together architectural design and heritage conservation follows. Finally, some thoughts on the idea of reconciling practices referred to in the title of this paper are presented.

HERITAGE EDUCATION AT UNIVERSITÉ DE MONTRÉAL'S SCHOOL OF ARCHITECTURE

The School of Architecture at Université de Montréal was established in 1964. Today, it is one of twelve schools of architecture at universities across Canada recognized by the Canadian Architectural Certification Board. The School offers a Bachelor's degree in Architecture which constitutes an initiation to the discipline. The three-year program focuses principally on learning about architectural conception and introduces students to the theoretical and critical aspects of the discipline. A Master's program was created in 2000. It is for students who have their Bachelor's degree in architecture and who wish to become professional architects.

Learning about heritage is not mandatory for architecture students either at the undergraduate or graduate level; the emphasis in both is on conception and design of contemporary architecture. At best, heritage is introduced as an optional lecture course or as a choice for a one-semester studio. As a result, the students can complete the two programmes over the course of four and a half years without ever having dealt with issues related to heritage conservation.

This situation in great part due to the fact that in Quebec, as is the case elsewhere in Canada, architects specializing in heritage conservation are not officially recognized for their specific expertise in the field. The professional associations such as the Order of Architects in Quebec do not recognize specializations within practice as such. Furthermore, unlike the United States, neither Canada nor its provinces and territories possesses a tax credit for the rehabilitation of historic places. As a result, any firm can intervene on a heritage building whether it is designated or not. In short, there is no incentive to develop that specific expertise.

That being said, a number of architectural firms are known as conservation experts by virtue of their portfolios. Their expertise is usually acquired via a post-professional degree in conservation such as the one offered at the Université de Montréal's Faculty of Environmental Design[2], through courses provided by continuous education or simply through cumulative experience. It usually consists of practical knowledge such as that of traditional materials and assemblies. But over the course of the last forty years, expertise in conservation has developed tremendously and now includes principles and guidelines for conservation, theory and doctrine about fundamental issues such as authenticity, interpretation and enhancement, and methodology for heritage value assessment.

DEFINING HERITAGE

So why is this lack of heritage education in schools of architecture a problem? Simply said, these future architects are entering practice without any tools for intervening in the built environment. Yet over the course of their career, it is highly likely that they will encounter heritage conservation issues when conceiving of a new construction in an existing fabric or by retrofitting an existing structure with either an addition or a redesign of its interior, or both[3]. The treatment of a heritage component will therefore rely on the architects' sympathy for history and on their intuition. While history and architectural history are indeed indispensable disciplines to determine the heritage value of a place, knowing about its history does not necessarily reveal its value. That might be the case for ancient and unique places – ruins from antiquity for instance –, or those associated with a famous person (the house where a politician was born or a Frank Lloyd Wright creation), or even buildings with ornate architectural features (such as a place of worship). But nowadays the definition of heritage includes much more than ancient and pretty buildings. It has evolved considerably over the course of the last four decades and now includes the legacy of the modern era, urban centers, vernacular architecture, landscapes and the intangible. More importantly, the evolution of the concept of heritage is not limited to this multiplication of heritage types. Rather, the past decade has introduced a shift in

paradigms. Whereas in the past, the aim was to conserve the fabric (the cornices, the ornamentation, the stone wall, etc.), at present the focus is to preserve the values. Places can still carry the heritage label because of their historical or their architectural value, but they can also be preserved for other motives such as a community's attachment (what is referred to as a social value), or the place's potential contribution to economic development (an economic value). Lastly, current interdisciplinary discussions between scientists and heritage practitioners are making a case for the ecological value of heritage in view of its capacity to reduce greenhouse gas emissions, therefore expanding architect and former AIA president Carl Elefante's oft-quoted statement, "the greenest building is the one that is already built"[4]. It is abundantly clear that these changing views about heritage are aligned with sustainable development[5]. As a result, determining what is important to preserve and why is increasingly a challenge, one that architects can no longer meet without a better grasp of all of the knowledge and experience of heritage that the field now offers. Furthermore, interventions for conservation are no longer limited to restoration and reconstruction. They are increasingly synonymous with reuse and adaptation, something design architects are already called upon to do. And finally, these actions do not concern buildings exclusively, but also sites, neighborhoods and even whole swathes of urban fabric. We have come a long way from the black and white / this-is-heritage-and-this-is-not context that endured from the 19th century. While intuition will always be a necessary ingredient in the practice of architecture, it can no longer be the single support for decision-making in a context where a heritage component is potentially at play. This complex new world requires an enhancement of the skill set that has been taught in the School of Architecture at Université de Montréal until now; hence the creation of this new course within the Professional Masters of Architecture program.

ARCHITECTURAL DESIGN AND HERITAGE CONSERVATION: LEARNING OPPORTUNITIES FOR BRIDGING THE GAP

The Master's program underwent an institutional review in 2014-2015. It provided an opportunity to create a stream which would enhance the design skills that students develop over the course of their education by including the theory and the methodology specific to the field of heritage conservation. The intent is to allow students to develop their critical judgement about how to respectfully insert a new design into an urban heritage context for their thesis projects.

This course raises some complex questions that all architects will inevitably face at one time or another in their professional practice:

- What is of heritage value in the built environment and why?
- What are the limits to transformation of a place before its heritage value is compromised?
- What new meaning will these interventions bring to this place?
- Do these transformations provide an opportunity for enhancement of the heritage?

World heritage provides the framework for this program, in particular the World Heritage Site of the Old Town and New Town of Edinburgh in Scotland which served as the site for the course's first edition in 2018, and Old Quebec in Canada for the 2019 edition.

Created in 1972, the *Convention Concerning the Protection of the World Cultural and Natural Heritage* remains to this day the UNESCO convention ratified by the greatest number of countries. The World Heritage List of places that have Outstanding Universal Value currently has 1121 sites inscribed. World heritage was chosen for this course for a number of reasons: firstly, because international discussion determines a great deal of thinking on heritage, much of which is subsequently adapted to suit regional and local realities. One has only to think of the concepts of

heritage value, of authenticity and of cultural landscapes. In addition, tools for analysis and management of heritage such as statements of value, conservation plans and heritage impact assessments also come from the international sphere. Finally, the high standards for conservation that are required at this international level lend themselves to thinking about their evolution and adaptation.

The program extends over the course of a full calendar year, from January to December. It is comprised of three activities:

- A research project studio (6 credits – winter term)
- A research seminar (3 credits – winter term)
- A thesis project (9 credits– fall term)

The seminar is closely linked to the research project studio. It is the means of communicating knowledge and understanding of contemporary issues in heritage conservation. It also includes a historic overview of the doctrine from the 19th century to today. In short, the content of this seminar (the theory) nourishes the reflection that takes place in the studio (the practice) which is taught by a group of educators that includes practicing architects. This studio's focus is not design. Its content includes documentation of the World Heritage site, site observation, and heritage assessments, all preliminary steps required prior to intervention according to the best practices developed by the heritage sector. Students are therefore exposed to the concept of values, which is widely accepted and used in the field, as well as the methodology and the vocabulary that come with it.

An in-depth understanding of the World Heritage site under study is the research project studio's basis. It is grounded in the notion that heritage is what we have now, it is what we have inherited. To acquire this understanding, the students spend half of the winter term documenting the site's current economic, social and physical aspects, thus familiarizing themselves with different disciplines such as geography, economics and sociology. This process is enhanced by a week-long stay in the historic centre where they meet different stakeholders, including architects, public servants and citizens' groups (figures 1 and 2). The aim is to appreciate how heritage values are embedded in the physical aspects of the city and in the ways people live. It is also to understand what role heritage plays in everyday life to ensure that their proposal for a new project inserts itself into this system and works with it for the long term. In short, we are teaching them that the quality of a contemporary insertion in the heritage fabric does not depend solely on its visual aspects but also on its use (or uses).

The research project studio concludes with the production of a brief which each student must present defining his/her intentions for the thesis project. This statement of intent determines the choice of a site to build on from a proposed list and a detailed program. The thesis project that students undertake during the fall semester is therefore based on the work done during the previous winter. In addition to their final project, the students must draft a design statement, a document modelled on the one required by the Scottish government for new projects, including those located in world heritage sites[6]. This fifteen-page brief must present the approach to the site and justify the decisions for the conservation of the values and the character defining elements that embody them.

RECONCILING PRACTICES

The two iterations of the course allow us to formulate some observations. First and foremost, the sensitivity and thoughtfulness displayed in the projects developed by the students demonstrate that a value-based heritage approach (and the method resulting from it) can lead to architecture that is decisively contemporary but that in no way impoverishes the heritage interest of a place.

However, these two experiments have raised questions about the possibility to achieve the overarching *raison d'être* of this course, which is to ensure that the next generation of architects is

prepared to take on the challenges that the new heritage paradigm presents. The most obvious question pertains to the knowledge required to fulfill this goal: did they learn enough about heritage? While from the outset, this stream did not claim to train accomplished specialists in heritage, the fact remains that one year and 18 course credits later, students have merely scratched the surface of the field's accumulated knowledge and experience. The necessary focus on conception and design of the thesis project – in order to satisfy the learning requirements of the professional Masters – left little time to deepen other heritage conservation issues relevant to the practice of architecture such as digital surveying, materials conservation and the preservation of interiors.

This question – how much knowledge is enough knowledge? - relates to a topic of discussion that comes up time and time again amongst heritage educators: should education in heritage be embedded in other programs or should it be a specialization? Should it be recognized as an independent body of knowledge or does it result from a convergence of several disciplines[7]? The field of heritage has yet to provide a definite answer to this lasting dilemma. The paradigm shift alluded to before makes it even more complex in view of the increasing number of disciplines susceptible to play a role in defining heritage and contributing to its conservation.

Moreover, time is also an issue: time to assimilate the theory and to apply it in practice. Considering the fact that the students started acquiring knowledge about heritage from first principles, their reflections about conservation in general and the theme of the reconciliation of practices did not have a chance to ripen sufficiently, limiting themselves to the impression that they were being put out of their "comfort zone" on more than one occasion during the winter semester! One can only wish that such a reflection will occur in the coming years as they acquire experience.

Nevertheless, the students walk away with a strong foundation, one they can add to during their practice, provided, of course, that they use their heritage baggage, something that is left entirely up to each and every one of them. At the very least, this program will allow these young architects to decode the existing built environment, to identify its heritage values and characteristics using, yes, their intuition, but also a rigorous methodology and critical judgement. In addition, I believe that the course has instilled a new curiosity about the existing environment and the reflex to ask questions about it. Inquisitiveness and curiosity can often make up for lack of knowledge.

In closing, it is my personal hope that this stream will also contribute to changing the negative perceptions about heritage conservation that continue to persist. Unfortunately, many architecture students still consider heritage unexciting. Many see it as an impediment to their creative freedom, an attitude which is not unusual to find in architects in practice. In return, heritage advocates are often quick to judge contemporary design negatively and to deny its positive contribution to the built environment. Yet it seems to me that both practices have a converging goal – to contribute to communities' overall quality of life. The reconciliation of practices begins with the recognition of the positive contribution of each practice, something that, in turn, depends on cultivating an open mind. This is where educators in architecture and in heritage in particular, have an important role to play by explaining the evolution of heritage – the new paradigm – and by conveying the message that conservation no longer equates to freezing a place in time, but is, more often than not, synonymous to change, change that can generate as much creativity and imagination as new design does. Equally, the reconciliation of practices is contingent on architects' capacity to strike a balance between confidence and humility, to be respectful and considerate towards heritage although not intimidated by it while demonstrating the necessary audacity to propose change. Herein lies the challenge for heritage conservation education, one that I am more than willing to take up.

Figure 1. Site visit of Old Town Edinburgh World Heritage site
(Photo credit: Benjamin Hamel)

Figure 2. Students and professors touring The World Heritage site of Old Quebec
(Photo credit: Vincent Hudon)

NOTES

[1] Claudine Déom, "Finding a Good Fit" in *REUSO 2015 : III Congreso Internacional sobre Documentación, Conservación y reutilización del Patrimonio Arquitectónico y paisajístico : celebrado del 22 al 24 de octubre, en Valencia* eds. Palmero Iglesias and Luís Manuel (Valencia : Editorial de la Universitat Politècnica de València, 2015), 2275-2282. In addition, a paper on the history of conservation education in Canada is in preparation.

[2] The Masters of Conservation of Built Heritage at Université de Montreal is a two-year program entirely dedicated to heritage. It was created in 1987. It welcomes students with different backgrounds such as art history, history and urban planning. It aims to prepare graduate students for a professionnal practice specialized in heritage conservation by providing them with the specific knowledge about heritage (doctrine; policy and framework from Montreal, Quebec, Canada and elsewhere in the world; precedents of interventions for conservation; etc.). The program also aims to develop the students' critical judgement to determine what is of value in the built environment and to develop the adequate strategy to preserve it according to best practices in the field. It comprises lectures courses, a studio and an optional internship. Additionnal information is available on the Université de Montréal website (in French only), accessed 18 August 2019, https://amenagement.umontreal.ca/maitrise-en-conservation-du-patrimoine-bati/.

[3] According to the American Institute of Architects' 2018 Firm Report Summary, "… a growing share of design activities is being dedicated to additions, renovations, rehabilitations, and retrofit to existing facilities, as well as to historic preservations activities" in the United States. The revenue income for such work is close to 45% of total revenues, up from 35% in 2009. The American Institute of Architects, *Firm Survey Report. Overview* (2018), 5, accessed August 18, 2019, https://www.aia.org/resources/6151-firm-survey-report.

[4] M. Smith Baird and Carl Elefante, "Sustainable Design in Historic Buildings: Foundations and the Future", *APT Bulletin*, 40 (2009): 19-26.

[5] This is confirmed by the identification of the conservation of heritage as a target to achieve Goal 11 of the United Nation's Sustainable Development Goals dealing with sustainable cities and communities. "United Nations Sustainable Development Goals" accessed August 16, 2019
https://sustainabledevelopment.un.org/?menu=1300.

[6] "A design statement enables the applicant to explain why the selected design solution is the most suitable in the circumstances –in terms of the building(s) and the quality of spaces created. A building may be good architecturally but if it is inappropriate for its context it may not contribute to a quality place." Scottish Executive Development, *Department Design Statement. Planning Advice Note no 68* (2003), accessed August 16, 2019 https://www.gov.scot/publications/planning-advice-note-68-design-statements/pages/2/.

[7] Jorge Oteros-Pailos, "Historic Preservation. A History of Historic Preservation" in *Architecture Schools. Three Centuries of Educating Architects in North America* ed Joan Ockman (Washington D.C. and Cambridge, Mass.: Association of Collegiate Schools of Architecture and MIT Press, 2012), 330-335 and Cameron, Christina, "Conclusion" in *PROCÈS-VERBAL L'interdisciplinarité et la conservation du patrimoine: de la théorie à la pratique / PROCEEDINGS Interdisciplinarity and Heritage Conservation: from Theory to Practice* eds Christina Cameron and Hélène Santoni (Montréal : Canada Research Chair on Built Heritage, Université de Montréal, 2015), 147-155.

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BOUNDARY NEGOTIATING ARTIFACTS FOR DESIGN COMMUNICATION: A THEORETICAL AND EMPIRICAL EXPLORATION

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INTRODUCTION

Interdisciplinary teams must figure out ways to navigate team members' differing disciplinary backgrounds and successfully communicate with one another. This can prove challenging because disciplines comprise unique cultures, goals, perspectives, epistemologies, methodologies, and languages.[1] Consequently, communication is among the most frequently cited challenges to interdisciplinary collaboration, and developing communication skills is widely recognized as an important facet of teamwork.[2] Yet, "Newcomers often underestimate the challenges of interdisciplinary work and, as a rule, do not spend sufficient time to allow them to overcome difference and create common ground, which in turn leads to frustration, unresolved conflicts, and…discontinued work."[3] Thus, it is important that teams establish common ground in terms of shared language, concepts, and goals.[4]

Boundary negotiating artifacts (BNAs) are one way in which interdisciplinary teams can establish common ground and facilitate communication between team members. BNAs are artifacts and inscriptions that coordinate perspectives and align different communities of practice so that they can collaboratively solve design problems.[5] They facilitate transmission of information across disciplinary boundaries, allow team members to learn from other disciplines, create shared understanding of a design problem, and communicate important information. The concept of BNAs emerged out of boundary object traditions in the field of Science and Technology Studies and is an attempt to overcome limitations of the original concept. More specifically, BNAs add nuance and depth to studies of the complex, non-routine projects which designers increasingly face as they work to address societal challenges. Focusing on the daily micro-level practices of designers reveals communication processes and facets of design work that otherwise remain unseen and are not revealed through either normative description of design work or through interviews alone. Boundary negotiating artifacts provide a framework to study just such daily micro practices and inscriptions.

We suggest that boundary negotiating artifacts are a timely and essential concept for multiple stakeholders in academia and the workplace. This paper presents a theoretical exploration of BNAs and their roles in design teams, supported by an empirical example from a long-term ethnographic study. The three-fold aim of this paper is to present BNAs as: 1) a theoretical and methodological tool

for other researchers, 2) a pedagogical tool for faculty members, and 3) a conceptual tool for team members themselves.

FROM BOUNDARY OBJECTS TO BOUNDARY NEGOTIATING ARTIFACTS

The concept of boundary objects was introduced by Star and Griesemer in their study of diverse groups (amateurs, professionals, and administrators) from different "social worlds" working together to create a science museum during the early decades of the 20th Century.[6] They found that two factors in particular helped enable successful collaboration among diverse individuals and groups, namely *standardized methods* and *boundary objects*. Boundary objects can be abstract or concrete objects that are:

...both plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual site use. ... They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation.[7]

Examples of boundary objects in Star and Griesemer's study included diagrams, maps, and repositories of items catalogued in a standardized manner.

Since their introduction, boundary objects have been taken up enthusiastically by scholars in multiple fields, and many modifications and additions to the original concept have been proposed.[8] For example, conscription devices, prototypes, intermediary objects, and standardized packages have all been proposed as necessary modifications or alternatives to the original concept.[9] Despite the fact many of these modifications retain the label of boundary objects, the modifications do not always meet the requirements of boundary objects.[10] Therefore, Lee argues that the concept is incomplete, and we should resist the temptation to treat boundary objects as a "catch-all for several theoretical constructs."[11] She elaborates:

The black boxing of boundary objects has entailed an uncomfortable separation between artifacts and the socially negotiated processes that give them meaning. ... By avoiding the temptation to treat the boundary object as a black box, we open ourselves to models of collaborative work that go beyond simple exchange to more comprehensive and richly specified models of negotiation and enactment.[12]

In other words, by developing a better ontology for the objects involved in collaborations, we gain nuance and deeper understanding of the distinctions between different types of objects, as well as insights about how their different uses affect collaboration. Other recent work makes a similar case for refining the ontologies of intermediary objects because doing so reveals how design work actually unfolds.[13]

From routine and simple to nonroutine and complex projects

In part, the limitations of the concept of boundary objects stem from the fact that there are many different kinds of projects, problems, and collaborative work, and the original concept may not be sufficient to describe and understand all kinds.[14] One way to delineate different kinds of collaborative work is to draw on Strauss' distinctions. Strauss developed a categorization schema that locates projects along two axes.[15] The first axis ranges from *routine* to *nonroutine*, where routine projects have "a project path that has been traversed frequently, clear anticipatable steps, experienced workers, an established division of labor, stable resources, and strategies for managing expected contingencies."[16] Nonroutine projects are not as stable and predictable. The second axis ranges from *simple* to *complex*, where complex projects have "many types of work, many workers and many types

and levels of workers, a complicated division of labor, variable workers' commitments, possibly more than one explicit project goal, and a complex organizational context for the project."[17] Simple projects are characterized by fewer people and kinds of work, minimal divisions of labor, singular goals, etc. The original concept of boundary objects was developed during a study that involved "a somewhat routine and fairly simple" project.[18] It is therefore possible that boundary objects are most appropriate for studying these kinds of projects, while for complex, nonroutine projects, on the other hand, a different concept may be needed to develop more nuanced, in-depth understandings of the work and objects involved. To this end, Lee introduces the concept of boundary negotiating artifacts, which are more appropriate for nonroutine and complex projects.[19]

A TYPOLOGY OF BOUNDARY NEGOTIATING ARTIFACTS

BNAs are "artifacts and surrounding practices to iteratively coordinate perspectives and to bring disparate communities of practice into alignment, often temporarily, to solve specific design problems that are part of a larger design project."[20] They include inscriptions such as sketches and concept maps. BNAs have a variety of different functions and affordances. They transmit information, facilitate collaboration across disciplines, create shared understanding of a design problem, and communicate concepts and techniques, among other functions. The original BNA typology, summarized in Table 1, emerged from a study of the creation of a museum exhibit.

Type	Purpose	Examples
Self-explanation	Record, collect, remember and organize information for oneself	Concept sketch, Notes, Journals
Inclusion	Propose new ideas, concepts, or forms to team members: a reference or symbol for the new idea	Sketches or drawings, Text summarizing a new idea
Compilation	Create alignment and coordination between the team members to bring them together long enough to produce a shared understanding of a problem and/or to communicate important information	Tables, Technical sketches
Structuring	Communicate a vision and compete with other structuring artifacts to make that vision dominant: push and negotiate boundaries between communities: establish ordering principles: direct and coordinate the activity of others	Narratives, Concept map
Borrowed	Taken from one community of practice and used unexpectedly in another, suggesting close relationship between communities of practice	Design collage

Table 1. The original BNA typology[21]

CASE STUDY

The empirical content of this paper comes from a year-long ethnographic study conducted at a public university in the United States in 2016 and 2017. In-depth observations, as well as interviews, were conducted with an interdisciplinary student design team. Data came from those observations, sixteen semi-structured interviews, and material sources that were created or used by the participants during group meetings or class activities to communicate and collaborate. These materials included diagrams and sketches, PowerPoint presentations, technical documents, design renderings, and prototypes. The

design project was part of a national collegiate competition to create green, sustainable living communities. The team was complex and nonroutine, comprised of multiple and overlapping sub-teams. Our primary observations were of architecture, computer science, and engineering undergraduate students and faculty members. Additional details about the methods are reported in greater detail elsewhere.[22]

We observed that the team largely focused on one *structuring artifact* in the form of what they called the "project narrative." Over-reliance on this one structuring artifact to produce shared understandings introduced challenges and tensions. In particular, one sub-team did not utilize enough *inclusion* and *compilation* artifacts, which have been found in prior studies to be highly important for successful interdisciplinary collaboration.[23]

DISCUSSION: BNAS AS THEORETICAL, METHODOLOGICAL, AND CONCEPTUAL TOOL

Studying BNAs in this project allows us to ask and answer questions such as: Which artifacts facilitate a shared understanding of a design problem? Which do not? Which most successfully lead to alignment between team members? Which artifacts get saved and are easily accessible, under what circumstances, and to what effect? How do artifacts shape team members' actions? How do team members communicate new ideas from their home disciplines to team members from other disciplines? Are some artifacts more successful at communicating certain ideas than others? What artifacts do designers create for themselves to make sense of assimilating, studying, or engaging material from other disciplines? Answering such questions provides new insights into interdisciplinary collaboration that have not been captured by other approaches. Furthermore, BNAs can have a longevity that conversations do not, allowing researchers to capture aspects of interdisciplinary communication and design that might otherwise escape notice or be lost.

Answers to these questions can then be translated into professional development materials for educators. Faculty members can proactively utilize BNAs to teach interdisciplinary teamwork and communication skills and facilitate their student teams more effectively. By examining BNAs, specific artifacts involved in communication processes can be identified, in turn revealing where problems in communication occur and how successful communication can be replicated and taught. For instance, if team members are producing different structuring artifacts, team leaders should be aware of that because it means that team members have different visions or understandings of the project and, consequently, of what members' actions should or will be. With the language and concepts from BNAs translated into faculty development materials, educators can teach students about BNAs to help students manage and negotiate their interactions with team members. Ultimately, creating such materials will be one outcome of this project. Furthermore, the conceptual tools provided by BNAs could also be translated into materials designed for student team members to help them navigate their interactions with teammates directly.

In sum, research suggests that studying BNAs can:

- Empirically advance the research landscape beyond normative assertions that interdisciplinarity and communication are important.
- Help designers, faculty members, and students navigate the challenges of interdisciplinary collaboration.
- Contribute to important learning outcomes for students, such as communication skills and multidisciplinary teamwork skills.

- Provide insights otherwise lost to memory and not capturable through other data collection methods because they are inscriptions.

ACKNOWLEDGMENTS

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LIGHT AND BUILDING SKINS IN DESIGN PEDAGOGY

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INTRODUCTION

The contemporary design pedagogy calls for the integration of evidence-based design. Demirbilek et al. discuss two methods of incorporating light in the architectural design studio, using digital tools versus physical models. The results indicate successes and challenges in learning the digital tools, whereas physical models are better perceived.[1] Treacy has also indicated the significance of including analogue and digital tools in teaching daylighting concepts in design pedagogy. The mentioned research provides an in-depth description of light qualities and the need for experiential explorations in our digital era.[2]

Vassigh and Spiegelhalter discuss an interactive educational platform, which uses a student-centered method to introduce best practices that promote carbon-neutral design.[3] The pedagogies that Treacy and Vassigh explore are quite different, in the sense that the former focuses on conveying the concepts through hands-on experience. On the contrary, the latter builds on the use of interactive graphics as a teaching tool for technical topics. Both of these methods are needed in our complex world. One of the methods to incorporate a deeper understanding of light and energy in buildings is to provide students with workshops on the topic of building skins. Building skins function as the protection against inclement weather, where the envelope design can improve the quality of indoor environments. Werner Lang discusses the functional, energetic, and structural aspects of facades in buildings, which is a great source for the students.[4] Advanced building skins aim at reducing the energy consumption in buildings, using an evidence-based design that couples the science and design to optimize building performance.

Energy and daylight analysis of building skins based on the location of the project, material, and window-to-wall ratio assist engineers in predicting the performance of the building. Daylight analysis of different designs is an example of evaluating how a building skin can function in different circumstances. With the high speed of software developments in Building Energy Modeling, it is necessary to educate students for future advancements based on giving them the foundations beyond digital tools. The evidence-based design looks ahead of the construction industry. As a result, its ability to make optimized designs calls for a need to educate students and faculty at the present time.

Architecture students are often introduced to the environmental and energy side of buildings in the senior years of the program. Some projects in second-year studios such as a building skin or passive house design are examples of early introductions of students to environmental issues in building design. With regard to climate change and the need for more energy-efficient and healthier buildings,

this paper proposes to start educating students with a sensible epistemology. This methodology emphasizes the fundamentals through analogue methods more than the use of digital simulation tools.

METHODOLOGY

This paper is shaped based on the observation of students' work after being introduced to the concepts of energy, innovative technology, light, and simulation tools in the upper division undergraduate level. The current work introduces a methodology to include light and energy concepts in different ways within an elective, the context of a design studio or digital fabrication course.

The pedagogy used in this study provides an experiential and digital understanding of light and evidence-based design, whereas the design studio and digital fabrication courses benefit from the experiential part and application of the pedagogy. The experiential part deals with the photography of light and shadows in study models, while the digital tools value the use of simulations and data.

Students are introduced to the concepts and basics of light and energy such as the fact that climate and building components affect light and energy levels in buildings. When the knowledge is acquired, students practice their learning with study models to design a space as a focused short project. Students learn to look for building orientation, locale, sky conditions, skin design, and materials. The following sections introduce the topics, samples of assignments, and students' work in the beginning and advanced levels. The overall method suggests providing students with discussions and design challenges that require the understanding of the fundamentals before moving towards digital tools.

INCORPORATION OF LIGHT IN DESIGN

1) Elective Course (Experiential and Digital)

It is not very often to find an opportunity to offer an elective in lighting, which will thoroughly cover the concepts of light and energy with hands-on experience, in addition to the use of digital tools. The lighting analysis section introduces students to the concepts of illuminance quantity and quality, daylight autonomy, glare, dynamic shading, and artificial light.

The following outline (Table 1) is developed based on research on opportunities for lighting and energy modeling education in design. Students are introduced to the fundamentals of light at the beginning of the class, light HDR photography, and false-color light visualization during workshops.

Module 1: Fundamentals of Lighting 　　Poetics of Light 　　Light Quality and Quantity 　　Light and Well-being	Assignments 1A. Poetics of Filtered Light (Case Study: 1 week) 1B. LightBox Physical Modeling (Short Design: 1 week)
Module 2: Lighting Controls and Visualization 　　Visual Comfort, Glare, Contrast Ratios 　　Distribution of Light and Luminaires Workshop 　　Innovative Lighting Solutions	2A. Comparison of 3 Luminaires (Analysis: 1 week) 2B. Innovative Lighting Solutions (Case Study: 1 week)
Module 3: Lighting Systems and Simulation 　　Best Practices-Net Zero 　　New Assessment Methods and Digital Tools 1	3. Building Skin and Luminaire Design Project with Local Lighting Professionals (Design: 2 weeks)
Module 4: Energy Modeling 　　Digital Tools 2 (Revit and Honeybee)	4. Evaluation of the Design, Using Simulation Tools (Analysis: 2 weeks)

Table 1. Example of the course proposal for a lighting elective in design

The second part of the elective focuses on the use of digital tools for evidence-based designs. Autodesk Insight[5] is a valuable tool which is recently developed to provide architects with energy efficient design scenarios as a BIM software. Moving towards BIM thrives collaborative work with different layers of information in a model.

2) Design Studio (Experiential)

The goals of the integration of light and evidence-based design in studio are as follows:

- To introduce the fundamentals of light, poetics of light and visual comfort
- To explore the impact of design decisions on light and energy
- To introduce innovative lighting and energy solutions
- To review net-zero buildings and best practices
- To experiment with energy modeling in BIM in the early stages of design
- Incorporation of light or evidence-based designs in the architecture studio has its own challenges and it could vary based on the instructor. This study incorporates light concepts through a short exercise to design "Poetics of Light" in Design Studio 3.1, which is a successful experience. The course begins with a photography exercise to capture light in student's physical models and have assignments to design for light. The class has also covered a workshop on the meanings of energy use and digital tools; however, the interpretation of digital tools was challenging for the students. Figure 1 illustrates the results of the exercise.
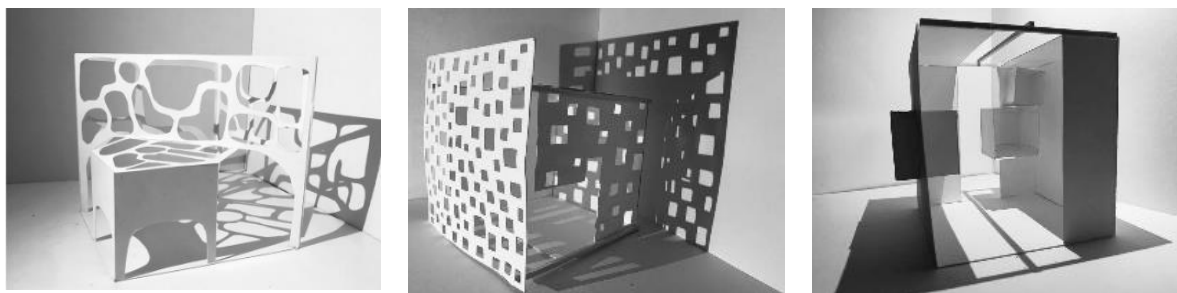
Figure 1. Integration of poetics of light (Design Studio)

This studio continued with the final project as a Sustainable Community center (COTE Top 10)[6] to introduce resilient design to students. The studio practices environmental concepts such as building form for energy, shading, earth-berming, water detention, and the use of PV panels. The results represented a grasp on the subject, where students were enthusiastic about exploring new avenues in design.

3) Digital Fabrication (Application)

This course introduces the concepts of parametric design and asks the students to design performance-based building screens based on their parametric design abilities in the class. This is a unique opportunity to engage different aspects and application of the design, since the students have the possibility to fabricate their designs. Students are asked to think about the applicable outcomes of digital fabrication and how a screen could be designed differently based on the orientation and the use of the facade (Figure 2). Coupling the idea of evidence-based design with digital fabrication is of significance, as it introduces a basis to evaluate parametric designs.
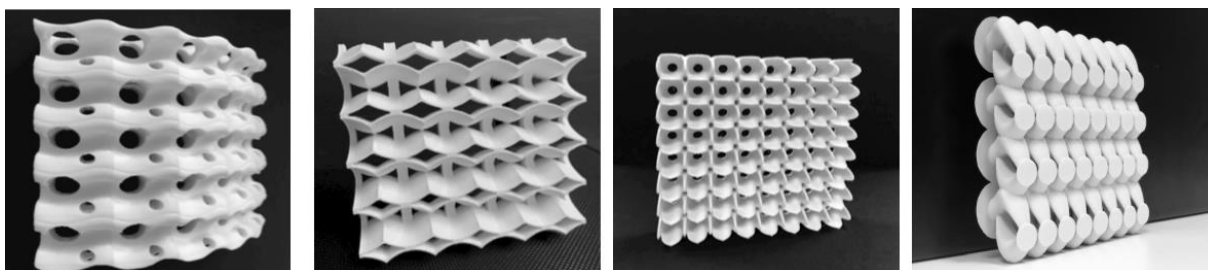
Figure 2. Integration of light in 3D printed building skin (Digital Fabrication)

EXAMPLES OF STUDENT'S WORK

Evidence-based teaching methodology is used in the elective course to make students familiar with the impact of design decisions on energy levels, light, and the environment. The course outline represents the topics and concepts covered in the class, combined with simulation workshops to assist students with interpreting the results on early stages of design. Students in this course have different assignments such as analysis and short design projects. Students' work in this course were mostly focused on assignments about concepts of illuminance, glare visualizations, and artificial lighting (Figure 3).

The measurements of light such as Daylight Factor or Climate-Based metrics are not sensible for architecture students. With regard to the materials that need to be covered in design studios and environmental systems courses, there is not enough time to experience the concepts of light. The method used in this elective demands the students to work with measurements of illuminance using a

sensor, comparing differences of Daylight Factor based on the interior qualities of light and finally stepping in the use of digital tools.

Prototype	Visualization	Daylight Autonomy	Glare

14%

27%
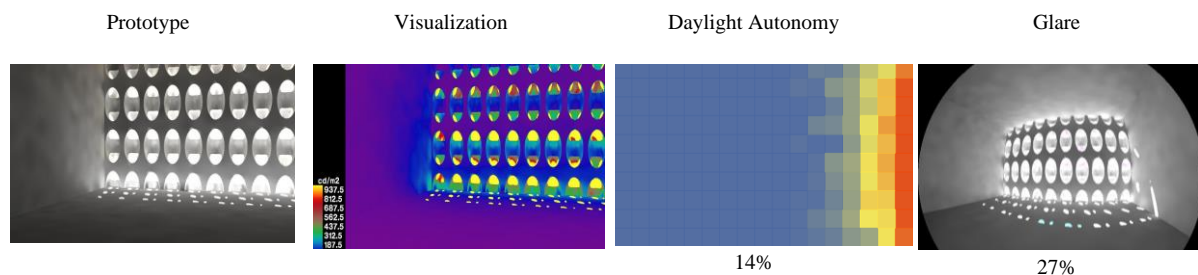
Figure 3. Example of exploring light in building skins (Elective)

The topic of artificial lighting and luminaires are often not thoroughly investigated in architecture design studios. Exploring this topic, furthermore, provides architecture students with a broader understanding of interior lighting design. Figure 4 depicts an example of integrating artificial lighting in a simple workshop for students to learn about luminaires and design options.
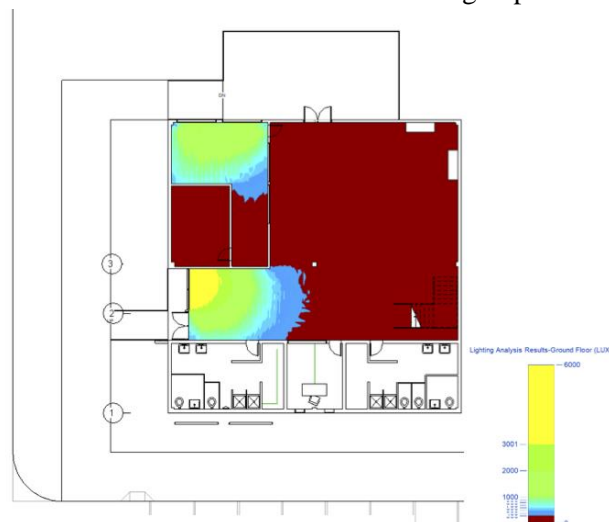
Figure 4. Example of student's work exploring artificial light in an elective course in design

The student's work in the studio focuses on experiential light design and provides the students with insights about the impacts of design on the energy use. The comparison between the student's work in different courses represents a depth of understanding based on each assignment. For instance, the digital fabrication course grasps onto the application of light in connection with fabrication. The observation of student's work projects that digital tools in lighting were most beneficial as an elective, where students could have a better grasp of the fundamentals. The results demonstrate that even though students learn more technical solutions in the elective, the subject is better perceived in the practical context of the design studio.

CONCLUSION

This paper reviews the significance of experiential design and poetics of light in a space prior to teaching the concepts of light quantities. The main contributions of the current study is to disseminate different ways to incorporate lighting and evidence-based approaches in design pedagogy. Methods vary based on the integration in an elective, design studio, or digital fabrication course. The elective

course thoroughly explores light measurement concepts and digital tools, whereas the studio integration is mainly focused on the poetics of light in design and building skins.

To incorporate light and evidence-based design concepts in a studio, instructors benefit from short lectures to review examples of light in design and ask for deliverables such as light photography. The same applies to assignments that reflect the design of building skins at the early stages of design, which are well perceived. This is a transitional method from the individual designer perspective to a team collaborator. Evidence-based design is one of the demands of our current industry, and students need to learn the concepts and its applications by means of a collaboration between lecture and design studio courses.

The evaluation of student's design work demonstrates improvements in the design skills based on the analysis of their projects. Students' results represent advancements in the following capacities:

- Understanding of fundamentals of lighting and energy concepts
- Understanding of visual comfort and contrast with regards to design decisions
- Learning and testing the impact of orientation, window-to-wall ratio, and skin design
- Exploring the impact of luminaires and innovative lighting solutions (Only in the elective)
- Using simulations to analyze, interpret the results and optimize early design decisions (Only in the elective)

Observation of students' work after being introduced to concepts of energy represents a deeper understanding of the subject; however, students have a more comprehensive experience working with physical models compared to digital tools. Introducing the idea of energy and light in design educates students about "evidence-based design" by building their decision on research. Teaching digital tools and simulation has its challenges, such as preventing students from showing results without knowing how to interpret them. Should the students perceive the concepts thoroughly, simulation becomes a valuable tool to combine aesthetics with research. Teaching the subject as a series of workshops provides an opportunity to integrate the concepts and practice the impacts on early design decisions.

NOTES

[1] Nur Demirbilek, Veronica Hansen, and Stef Gard. Daylighting Design in the Architectural Design Studio. 43rd Annual Conference of the Architectural Science Association, Tasmania (2009).
[2] Gillian Treacy. Out of "touch"? – An experiential pedagogical approach to daylighting in architecture and interior design education. SHS Web of Conferences 64 (2019).
[3] Shahin Vassigh, Thomas Spiegelhalter. Integrated Design Pedagogy for Energy Efficient Design: Tools for Teaching Carbon Neutral Building Design. Energy Procedia 57 (2014).
[4] Christian Schittich. Building Skins in Detail. (Walter de Gruyter, 2012).
[5] Autodesk. "Insight 360" accessed June 2019. https://insight360.autodesk.com
[6] American Institute of Architects Committee on the Environment (COTE Top 10). Retrieved Dec 2019
https://www.aia.org/awards/7291-aia-cote-top-ten-for-students

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FERNANDO TÁVORA AND THE UNITED STATES: TRAVEL AS A TEACHING PRACTICE

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INTRODUCTION

The importance of travelling accompanied the architect Fernando Távora from the very beginning of his architectural training and continued as an element in the development of a method for the evolution and progress of his own cultural growth and advancement of his research towards the end of his life.

The journeys undertaken were varied: a few trips to Spain, Italy, a trip around Europe in 1949 following trips on the occasion of the CIAM. His formative years concluded with a trip around the world, thanks to the subsidization of a scholarship from the Gulbenkian Foundation in Lisbon, allowing him, over a period of four months in 1960, to visit countries including the United States, Mexico, Japan (where he participated in the World Design Conference in Tokyo), Thailand, Pakistan, Lebanon, Egypt and, finally, Greece. It is on this trip that he would write a voluminous diary of reflections and drawings.

During the trip, that he would always consider as the most significant of his life, and by far the most fundamental of his training experiences, Távora witnessed the architecture of Frank Lloyd Wright and the American architecture of Mies Van der Rohe, and Luis Kahn em Philadelphia [1]; he observed and noted the character of the city and the various ways of life of other cultures; in America, he would go in search of new methodological meanings on teaching and the workings of regional authorities. He systematically located and sent books and materials on to his employees in Porto.

The call for the "*Study Scholarship - Higher Technical Secondary Education: Science, Literature and Art*", subsequently awarded to Távora, was made by the Calouste Gulbenkian Foundation on March 19, 1959, and published in the newspaper "*O primeiro de Janeiro*" on the same day.[2] The Call Announcement for the award of the scholarship abroad stated in its "Regulations" the conditions to which the scholar must adhere. The document stated that The Calouste Gulbenkian Foundation grants Scholarships for artistic development to graduates of courses of the Fine Arts and Decorative Arts School and to people who, despite not yet in possession of a qualification, make art their profession. Távora applied for the scholarship on April 27, 1959, as demonstrated within a Gulbenkian Foundation document entitled "Bolsas de Estudo no Estrangeiro - Boletim de inscrição" indicating the objectives of his trip and the universities that he intended to visit. The country in which the internship is to be carried out is *United States of America*; and course to be followed or scientific area to be studied: *Architecture departments of various Universities and Institutes*. Távora indicated that the

program of study or work plan to be followed are *Studies of teaching methods of Architecture and Urbanism in the following universities and institutes: Columbia University, Howard University, Harvard University, Massachusetts Institute of Technology, Institute of Design*, during four months. [3]

INTERNATIONAL MODELS

The main objective of the trip, therefore, is to understand the methods of teaching architecture and urban planning, in a selected choice of American universities. The universities he visits are the Graduate School of Fine Arts of the University of Pennsylvania in Philadelphia; Columbia University in New York; the School of Art and Architecture at New Heaven; the Graduate School of Design in Boston-Cambridge; the MIT of Boston.

This interest actually has a sequence of precedents related to the reform that Portugal had experienced regarding the teaching of architecture and which sees Carlos Ramos the main protagonist of this change. Carlos Ramos has been invited since 1940 as a professor of architecture in the School of Fine Arts in Porto. It involves other architects and teaching professors, giving life to a true innovative pedagogical action, comparable to the attempt that Walter Gropius makes when he tries to build a modern school at Harvard starting in 1937. The need for a renewal in teaching in Portugal arises from an obsolete persistence of a Beaux-Arts approach that came from the Reformation of 1931-1932, and that did not contribute to the necessary updating of an architect's higher and specialized training. This approach involved the formation of an architect-artist, in contrast to the formation of the technical architect that the 1950 reform and its subsequent regulation will demand to propose. Távora remembers the Reformation as "an update (of the traditional school) with an Anglo-Saxon reference model" and adds "it was not a way to turn the page, but to progress". (Maddaluno 2005, 288)

The proposal is the result of a careful analysis of the international teaching situation, as can be seen, for example, from the constant references to CIAM, and from the translation of Walter Gropius's program for Harvard school, known after its publication in L'Architecture d'Aujourd'hui. (Gropius 1950)

Harvard school has conveyed the ideas of the Bauhaus, through a constant and committed presence of teachers who have formed a veritable team of educational action around Gropius. The new teaching proposal is based on two fundamental pillars: experience and democracy, as opposed to the old pedagogical method that saw learning as a passive process in which students were not stimulated to develop critical thinking. This method of "learning through experience" is introduced by John Dewey. (Dewey 1971). This "new education" or "progressive education" of Dewey, also reflected in Portugal from the early years of the Republic until the 1960s, in the defence of an "education for freedom" through the action of António Sérgio, who was perhaps the one who most integrated Dewey in his reflections, in his brief action as Minister of Public Education.

TEACHERS AND LEARNERS

With a self-discipline that distinguishes him on this journey, Távora visits institutions that are important for urban planning, attends some lessons, and memorizes his criticisms that will certainly be reported in his diary.

Távora visits Columbia University between 29 February and 11 March 1960. (Távora 2012, 81-129). His conclusions and comments on this school are often very critical. Some examples: when he attends a lesson on "structural designs and planning in wood and steel"; when he meets Oronzio Maldarelli, professor of sculpture for architects, (Távora 2012, 111), of which despite appreciating his ideas he does not find the same quality in the final works. He is also critical when he sees an evaluation of the work of a commission, including Prof. Rieger in which he recognizes the same fragility, the same

potential, the same misunderstanding among the members of the commission, who had lived in Portugal. Not all events cause him to have a critical attitude, some organizational choices of the university intrigue him due to their unusual nature. Like when, for example, he discovers that Prof. Hagman teaches a "graphics" and "drawing" discipline to some engineers who want to give a more presentable form to their professional work and being even more intrigued by the fact that the assistants of the "Graphics" discipline are "undergraduate" students who attended the "graduate" course thus having the possibility of maintaining their studies. (Távora 2012, 128).

The attitude with which he relates to teaching and learning changes substantially when he visits the School of Art and Architecture at New Heaven. Here he recognizes and appreciates the value of the presence of Paul Rudolph, whose influence is evident both in the quality of the works and in the efforts made to move away from the Bauhaus model. (Távora 2012, 141). Note the importance of "design" taught to non-architects and vice versa the technical preparation that is required of architects, obtaining, according to him, a certain unity of academic and professional training.

The parallels between the two models, the Portuguese and the American, accompany him in every experience he has in these universities. Sometimes he appreciates the innovation, sometimes he sees the Portuguese superiority, other times he comes to conclusions that put them on the same level.

For example, the informal character on which the relationship between students and professors is based is a novelty for Távora: when he When he sees this way of working, he feels a genuine spontaneity that the Portuguese school had already lost by that time, due to intellectualism of their work. This result, comments Távora, is possible because this practice is born of a profound respect that is taught to students in properly dialoguing with the nature of their materials used. He acknowledges that a certain existing tendency to copy, academically, the forms created by the Bauhaus is still fought. (Távora 2012, 150)

And in this process of moving away from the danger of homologation with the masters, Paul Rudolph enters with great pedagogical merit, and Távora underlines once again when he has the possibility of being part of a commission for the evaluation of some works of the 3rd year (a museum of modern art). The commission is composed of four professors of the School, including King Lui Wu and Paul Jean Mitaraschi, by Prof. Eduard Seckler of Harvard and an architect representative of MOMA. His spontaneous and sincere appreciation leads him to conclude that thanks to the influence of Rudolph, the position of the first woman that Mies had represented until then is no longer perceived by the students. (Távora 2012, 150)

Between 22 and 25 March, Távora visits Harvard, the Graduate School of Design. He is introduced to the problems of teaching by Prof. Walter F. Bogner, Deputy Director of Architecture, who illustrates through a plan of the organizational and pedagogical structure of Harvard. He is still a professor at the school which makes him aware of the details of the organization and teaching methods at Harvard. He talks about the problem that the school has in negotiating with professors, because most, being architects, do not give up having their own architectural firm, and very often prefer to work freelance to teaching, for the obvious economic advantages. This non-exclusive dedication to teaching sometimes distances or tarnishes the relationship established between teachers and students. The general idea of the course, as prof. Bogner, is intensely preparing students for "design" and preparing them for a positive relationship with specialized technicians. He explains that at that time Harvard had 130 students of architecture and about 18 professors, which gives a proportion of 10 students for each teacher, without counting the "visiting critics".

He meets Luis Sert, who at this time is the director of the university, with whom he has a private interview, in a convivial invitation to his home, where conversation ranges from politics to economics, to the pleasure of living well. Among things in common and some differences, the

meeting ends with an eternally debated and unresolved question, which represents very well the American society that Távora finds: where does the value of things lie? In a life conducted with sobriety and tranquillity or in the constant excitement of having to possess at all costs (two cars and a house of your own)? (Távora 2012, 172)

His experience at Harvard ends with the observation that the professors, given their continuous relationship with the various disciplines, have a critical amplitude and an extraordinary mental flexibility, because they are able to pass from design issues to socio-economic issues, or questions related to traffic and transport. (Távora 2012, 174)

THE IMMENSE MACHINE

The trip to the United States helps to reinforce a deep feeling of Portuguese identity in Távora. The excesses, the contrasts, the anomalies, the accelerations, the organizations, bring it back to their respective opposites: the uniformities, the delays, the disorder, the silence, the slowness. The modernity manifested and sought with voraciousness by the American society of the early 1960s, leads him to a continual emergence of memories, linked to moments, sometimes intimate and familiar, sometimes cultural and social, of a Portugal that he will never abandon. (Figueira 2012, 39)

He reports it all, he says in the pages of the diary, to think that he was the only person alone among the 8 million New Yorkers, or in the midst of the approximately 20 million who depend on the city. From time to time, he could speak a foreign language, but the absence of Portuguese sounds linked him to the condition of a shipwrecked person who was denied the right to a last life raft. (Távora 2012, 107)

This is a journey that lives with a profound sense of disorientation. He feels a foreigner, albeit in a temporary sense. And this sense of non-belonging to a culture, which although you admire for its diversity and overt modernity, leads him to search strongly for ties to his roots: for example, he goes to mass on Sunday, writes to his loved ones (wife and son) almost every day, he sends books for the School in Porto, he is constantly looking for glimpses of a latinity hidden in the "immense machine" that this America is.

In this regard, starting from a conversation he has with Ing. Mario Salvadori, Italian and professor at Columbia, Távora repeatedly refers to the idea of "dynamism" of American society. This dynamism is noticeable in all its forms, and it is not only in its most evident manifestations, for example physical movement or traffic, or the growth of the American cities, but also in the movement of money. Távora comments that money does not stop, it is necessary to spend it, as if it were a mysterious phenomenon that starts from an uncontrolled desire, a kind of *fado,* to spend. In every corner, says Távora, there are automatic machines to spend money and buy anything, from chewing gum, to tobacco to food, up to the large funds, memorials, shops, associations, churches, etc. An unbridgeable desire to earn as much as possible and then spend as much as possible. (Távora 2012, 96-97)

It is as if Americans were constantly looking for something that is always beyond what is available. (Távora 2012, 121).

And as a symbol of this permanent agitated state of soul and body, the watch is used, which everyone looks to "control", verify, redirect, communicate impatience. Távora says, with his subtle irony, when he meets Ing. Salvadori, who understands that the meeting was coming to an end, because the engineer had looked at the watch twice. The clock, he continues, is one of America's great machines because movement involves time and time implies the clock. (Távora 2012, 121).

A look at the watch is a sign that time had to continue its hectic course, and that the moment of "pause" dedicated to conversation was over. This is what happens to him when he visits the office of Skidmore, Owings and Marrill, where Mr. Ernest Durhan, who has the task of showing him the office

and the architectural works, looks at his watch and exclaims "Well, good...." To inform him that he has run out of time.

Measured time, the *cronos*, is actually a condition that belongs to Távora in some way, but that belongs to it in the form of a disciplined organization of its work. The diary, for example, is the measure of this time, every day is written with abundance and rigor. However, it does not belong to him either as a condition of the feeling of living, and neither culturally. He is Portuguese, the heir of a culture that offers all the slowness that he needs in time and in the spoken word. Conversing, discussing, stopping, reflecting, are conditions that you will encounter in other places of your journey; in Greece for example, where, among the differences, you will find cultural neighborhoods that will make you abandon the feeling of being "outside" of home. (Maddaluno 2018, 61)

In the frenzy of his appointments and organized meetings, there come moments in which he necessarily feels the need for relaxation, and recognizes that Americans also feel this need, but not as a starting condition, but rather as a necessary consequence of a life led under the EXCITEMENT banner. It says that American life takes place around three nouns: MOBILITY-EXICITEMENT-RELAXATION. And that the people who come here, start with "mobility", switch to "excitement" and then feel the need for "relaxation", and then start again with mobility, thus continuing until the final relaxation. With a pungent sarcasm, talking about death, he says that nobody wants the dead at home, because when someone dies, they are immediately sent to a Funeral Home, Home and not House. He points out that funerals are very expensive, on the other hand it is natural, considering how expensive life is, what price death could have had if was not high? (Távora 2012, 178).

On this journey we often find ourselves reflecting on the concept of the "mobility" of the American family. He notes that 20% of families change homes once a year, or because their family composition changes, they get married, have children, children leave home, or due to changes at work. Therefore, people are led to frequent change. And this makes it, according to Távora, that the sense of "home" as the center of the family and as a physical element that symbolically guarantees the continuity of generations does not exist in the United States. On the other hand, he acknowledges that this condition is typical of the American pioneer spirit, which is built today to abandon tomorrow in search of a better condition. On the other hand, as he himself points out, there is a fundamental reason for all this: all the emigrants who created the United States emigrated not to stand still, but to do something, otherwise they would have remained in their countries of origin. The sense of emigration, according to Távora, lies in not recreating similar conditions in the place where one arrives. (Távora 2012, 191)

CONCLUSION

Távora wrote in his diary every day, noting every event with a journalistic richness, every issue, every name, with a self-discipline that seemed not to want to leave space for time, for revision. It should not be overlooked that the objective of the Távora diary was a final report that the Gulbenkian Foundation required as a condition of the scholarship. [4] This report would never be delivered. [5]

Távora feared "distant memory" and wanted an ordering of the data available in order to make it simpler and the task of transmission more objective. He instead lived this particular journey with a strong sense of persuasion, possessing a sense of one's life in the present, the will to live the moment, every moment, not just those seen as privileged or exceptional. Every appointment, every means of transport, each address is gathered in his experience with the same desire to record the presence, perhaps for fear of losing them in a subsequent revision of memory.

It is clear that all of these concepts relating to the form of experiencing reality and the way in which this experience becomes part of our consciousness are related to the theme of TIME. It seems that he intends to communicate that architectural discipline is transmitted through "measured", "solid" time.

Yet when the experiences begin to become memories in his stories, in his lectures, in his didactic drawings, time thus takes the liberty of the imprisonment of MEASUREMENT, and is lost, is diluted in an unchangeable impossibility of returning to the codified rules of history. Does a more appropriate form of time exist to "transmit" a "lesson of architecture"? All of this leads us to reflect on the theme of the transmission of the architectural discipline, on the most appropriate forms to teach or learn. What does being a MASTER in architecture mean? We could assume two forms recognized as defining its meaning. One involves masters "imitating" a model: in this case the teacher is simply a transmission "channel" bringing a wisdom that somehow does not belong. Alternatively, the other involves being a master by becoming an "example": in this case the transmission takes place through "showing", showing by doing or showing by saying.

Távora's travelling may fall into this form of transmission. In the Gulbenkian journey Távora plays a dual role: as a learner (when visiting the US University) but with the aim of teaching others what he has learned. (Maddaluno 2018, 63). [6]

NOTES

[1] Between 1958 and 1969, Frederico George and Luís Fernandes Pinto (1958), Fernando Távora (1960), Raul Hestenes Ferreira (1962-63) and Manuel Vicente (1968-69) came into contact with Louis Kahn in the Philadelphia School. Manuel Vicente attended Kahn's studio in 1969-69 and remembers that Kahn proposed an exercise in "A school" to study the concept of school. This type of experience would definitely have a following when Raul Hestnes and Manuel Vicente will be invited in the early 70s as design professors, the first between 1970 and 1972 and the second between 1970 and 1976. After Távora, other architects moved abroad for short periods trying to understand the new emerging realities: José Pulido Valente (Center Scientifique et Tecnique du Batiment, Paris, 1966), Cristiano Moreira (Finland, 1960), Alcino Soutinho (Italy, 1960). For the United States, part Raul Hestnes in 1962-63, Manuel Vicente in 1968-69 and Duarte Cabral de Melo in 1970-71. Gonçalo Esteves de Oliveira do Canto Moniz, O Ensino Moderno from Arquitectura A Reforma de 57 e as Escolas de Belas-Artes em Portugal (1931-69), Dissertação de Doutoramento em Arquitectura Departamento de Arquitectura Faculdade de Ciências and Technology from Universidade de Coimbra, Julho 2011, Vol. 1, p.21 (Moniz, 2011)

[2] Mesquita, A.R.C. *O melhor de dois mundos a viagem do arquitecto Távora aos EUA e Japão - diário 1960.* Master's Thesis in Territory and Memory Architecture. Fig. 5, p. 29.

[3] Document present in the Calouste Gulbenkian Foundation archive.

[4] *II - Obligations of the Fellow.*
The Fellow has the following obligations:
*1. Produce a report to document his activities as a Fellow, possibly with photographic documentation of the work carried out during the internship. In the event that the Fellow has chosen an artistic counsellor for his studies, he shall attach to the report a description of the same, demonstrating their commitment; (*Mesquita, A.R.C.. Fig. 8, pp. 35-36)

[5] Ana Mesquita in her thesis reveals the existence in the Távora archive, before it was transferred to its present location at the Fundação Marques da Silva, of around forty A4 pages in which Távora attempts to structure his report, organized into chapters, and that while generally incomplete, they provide clues as to how a possible final report of the trip could have looked. Being a rough draft, there are various modifications and revisions of perspectives with respect to the notes written within the Diary. (Mesquita, A.R.C. Note 366, p. 203).

[6] For the preparation of material on the occasion of the publication on Távora, I had the opportunity to work on the archive of Távora who had chosen me as a privileged "listener" of his travel diary, which he read over various months during my stay at his studio in Porto, page after page. I had the foresight to record his voice while reading the text as well as his comments and, suddenly, his trip was transformed from not only writing, but sound too, a sound that wavered depending on Távora's physical and emotional state. There are pages in which his voice is lively and animated, describing the experiences transcribed with a playful enthusiasm; there are other pages in which the weariness of old age does not allow him to maintain the same pace in his reading and the memories were not as easily recalled. Yet in all those memories there is a desire to relive the journey and transmit its importance, always with great force. The critical version of the Gulbenkian Travelogue in Italian is currently in preparation, with live comments made by Távora during his reading. The publication is a collaboration of the present author with Giovanni Leoni and Antonio Esposito.

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A CONVERSATION OF SCIENCES: DESIGN PROPOSALS FOR CLIMATE CHANGE ADAPTATION AS INPUT AND VISION FOR INNOVATIVE POLICY IMPLEMENTATION

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MANGROVE MANAGEMENT: SUSTAINABLE CUSTODY AGREEMENTS IN THE GULF OF GUAYAQUIL

In Ecuador, mangroves are concentrated around river estuaries, with the largest single area being around the Guayas River estuary and Guayaquil Gulf [1]. The Gulf of Guayaquil is a fragile estuarine ecosystem that besides hosting a large extension of Ecuadorian mangrove, is the home of local species and ancestral communities. These human settlements have lacked from the attention from different levels of governments and clear evidences of this are the lack of public infrastructure and services such as potable water, sewerage, waste collection, health and education. Certain settlements have received cooperation from NGOs and technical assistance foundations. In some ways these communities have been recognized to have "social innovation" practices because they are empowered and cover their needs in different ways despite the government´s lack of attention. However, in terms of adaptation to climate change, prevention measures have not yet been taken by the government or the communities, making of it a field of action that remains underdeveloped. This research aims to raise awareness for the need of designing and developing adaptation measures, considering the socio-ecological conflicts that exist in the area and the socio-economic dynamics of the stakeholders.
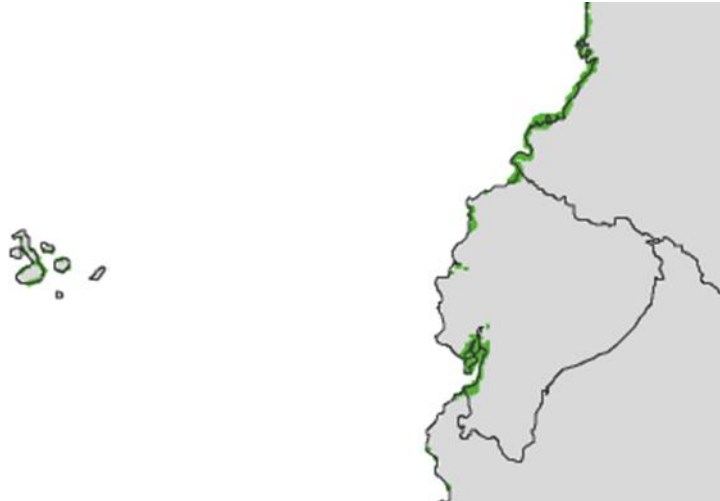
Figure 4: Mangrove in Ecuador.
Source: Mapping mangrove by satellite
https://eoimages.gsfc.nasa.gov/images/imagerecords/47000/47427/global_tm5_mangroves
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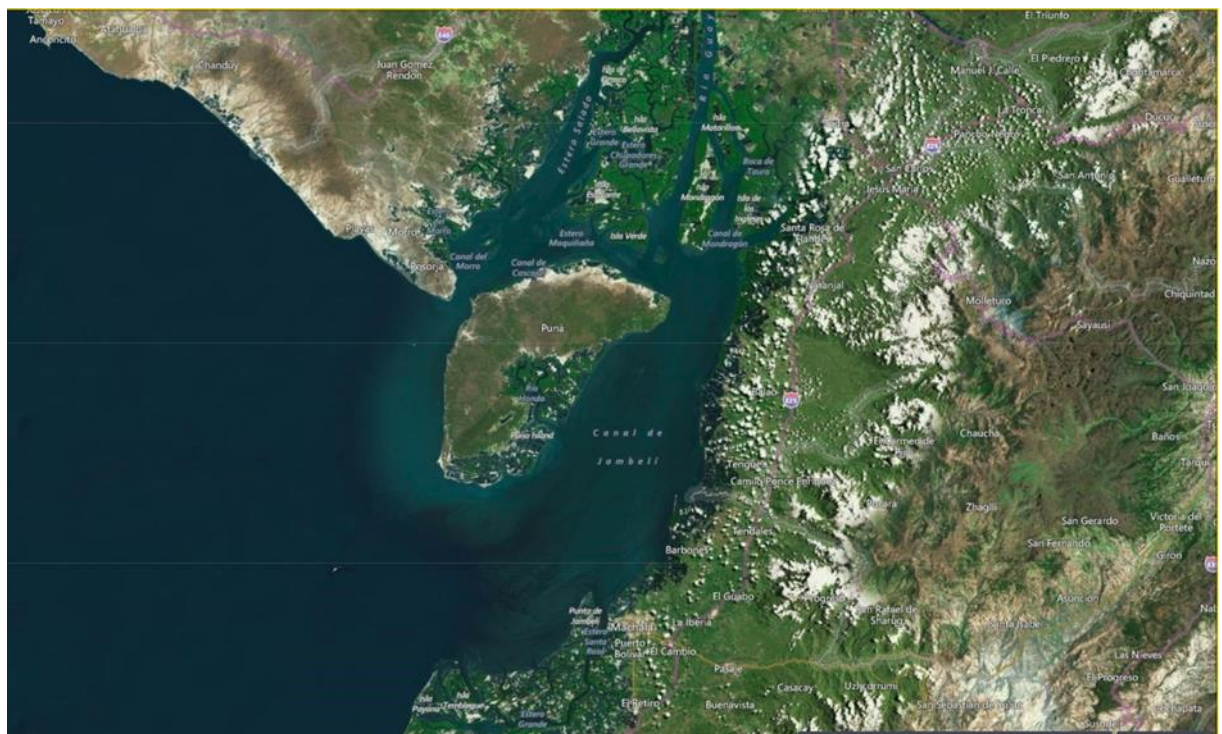
Figure 2: Gulf of Guayaquil: Estero Salado, Río Guayas, and Canal de Jambelí.
Source: http://www.geoportaligm.gob.ec/portal/index.php/visualizador/. Instituto Geográfico
Militar, 2017.
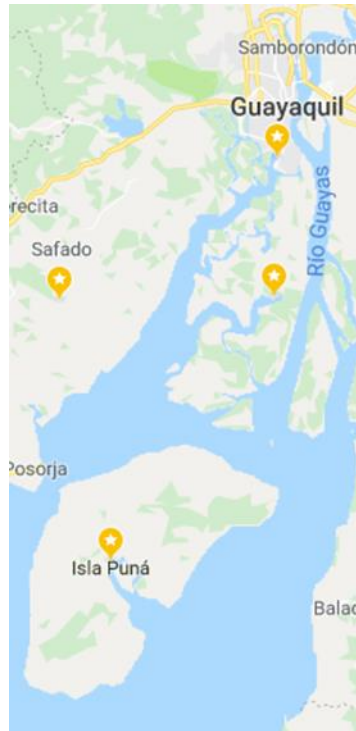
Figure 3: Guayaquil city and the Gulf of Guayaquil (Guayas River Estuary).
Source: Google Maps, 2019.

Figure 4: Houses and livelihood in one of the communities in the Gulf of Guayaquil
(Cerrito de los Morreños). Source: Author, 2018.

Figure 5: Boats outside the houses in Cerrito de los Morreños. Source: Author, 2018.

Figure 6: Houses in the community Cerrito de los Morreños. Source: Author, 2018.

From the environmental management perspective, since 2000 the area is operated under "sustainable custody agreements". These are legal instruments that entitle organized community groups, usually productive associations or "*cooperativas*", with the responsibility to sustainably exploit, and execute control and custody of the hectares that are defined in the agreement, as part of the territory of the organizations. The main source of income of these communities is the capture of crabs (*ucides occidentalis*) and catch of fish, that are sold in the local markets. The agreements have made a difference in the way the Ecuadorian mangrove has been managed, since they were built upon the proven assumption that communities are capable of managing their own territory and are an example of a "paradigm shift in costal and fisheries management from "top-down" to "participatory" co-management policies that empower local communities as legitimate stakeholders"[2]. In this way sustainable custody agreements are an example of respect to *ancestrality*, and trust in the community's work. At the moment, there are 20 custody agreements operating in the area of the Gulf of Guayaquil (Guayas province).

SPATIAL CONFLICT: COMMUNITIES AND SHRIMP FARMS

Despite the fact that communities manage their territory and report irregularities that occur in the mangrove area, there is low or none effect of these constant reports. Communities complain that for many years they have been filling reports, writing documents and attaching pictures to evidence the main problem they face in the area, which is the irregular felling of mangrove by the shrimp farmers that share the same space of the Gulf. Shrimp farms are located in the Gulf through "concessions" made by the Ecuadorian government to private businesses that use the area to produce shrimp, therefore the area is public but given to privates under concession. The area is a mix of mangrove and salt flats. The felling of mangrove affects directly to the communities since they rely on the sales of crabs that are caught in the Gulf. Shrimp farmers fell mangrove to transform them in shrimp ponds, which are no longer the adequate ecosystem for crabs but for shrimp production.

The second most important problem about sharing the space is the general complain made by the associations about the use of "metabisulfite", a toxic element that is used in the productive process of the shrimp farms and pollutes the water of the Gulf. In the "2015 Evaluation of the Socioenvironmental Management Plan" of the mangrove area "Cerrito de los Morreños", written by Rebekka Balser[3], is recorded as one of the top-of-mind concepts that users mention when they were interviewed about the efficiency of the filled reports; they said the reports are not effective because shrimp farms continue using metabisulfite. This is not only a practice that had occurred in the past; recently on July 24th of 2019 there was a meeting between the "Union of Crab Collectors of the Gulf of Guayaquil" and authorities of the Ministry of Environment to discuss about issues that affect the communities, and mangrove felling and the use of metabisulfite by the shrimp farms were identified as the main problems.

Figure 7: Picture that shows the use of land for shrimp ponds next to the Guayas River.
Source: Google Maps, 2019.

THE CURRENT SITUATION: VULNERABILITY TO CLIMATE CHANGE

Guayaquil is the biggest city of Ecuador and known as one of the cities worldwide that will experience the highest average annual losses (AAL) due to climate change[4], as exposed in Hallegatte et al. (2013). The latter is an emergency call for cities that have not invested in adaptation infrastructure, because this lack of preparation will cost them more in the future. Guayaquil is affected by light and heavy floods on a frequent basis that have an impact on the citizens´ day-to-day activities, the consequences are evident in road damage and heavy floods in several areas of the city. Maintaining the current flood probability, Hallegatte et al. estimate that Guayaquil will have an AAL of 0.95% of its GDP. This is considered a high AAL specially compared to the list of cities in risk, because out of the 20 cities only 2 of them have AAL over 1% (Guangzhou 1.32% and New Orleans 1.21%) being Guayaquil the third one[5].

Following the Intergovernmental Panel on Climate Change (IPPC) methodology, the Ministry of Environment (2001) generated three scenarios for the Guayas River Basin and the Gulf of Guayaquil (see Figure 2): Basic LANM0, Moderated-LANM1 and Severe-LANM2, considering sea level rise, rain, and increase of water and air temperature. The first scenario which is based on 0 meters of increase of sea level rise and normal increase of air and water temperature, being the most benign is translated into 301.5 km^2 of mangrove loss and 171 km^2 of shrimp farm infrastructure loss. In the Río Guayas Basin (from its origin to the Gulf) the total population affected under the severe scenario will be 327.005 evacuated and 204.787 in danger[6]. It is necessary to consider that mangroves act like cushions and give coastal protection, therefore their health is important for climate change adaptation and mitigation and helps maintain the livelihood of the communities that rely on the resources that live in the mangrove ecosystem, as well as the shrimp farms´ infrastructure.

All these indicators clearly expose the critical need to define adaptation measures for the Gulf of Guayaquil. As it was exposed before, there are particular characteristics of the area, such as the presence of ancestral communities, custody agreements and concessions for shrimp farms, that will play a fundamental role in the design of solutions.

FIELDWORK IN THE GULF OF GUAYAQUIL (CERRITO DE LOS MORREÑOS) AND MAIN FINDINDS FOR THE DESIGN PROPOSALS

With funding received by the International Master Programmes (ICP) and by The Belgian Development Cooperation (VLIR-UOS), the Master of Human Settlements (Faculty of Architecture) at *Katholieke Universiteit Leuven* (KU Leuven) organized an intensive fieldwork in the city of Guayaquil and the Gulf of Guayaquil (community Cerrito de los Morreños) for a group of master students to design proposals for climate change adaptation. Specifically for the Gulf, the students had different backgrounds related to urban development, architecture and public policy, and the results were three different landscape architecture design projects and a written thesis about the history, institutional-social dynamics, and climate change effects in the area. This paper is going to develop the analysis of one of these projects, called "Reverse Colonization", making inferences about the necessity to implement it, and considering the challenges that this design proposal implies in the public policy arena, stitching all these topics with the use of GIS for innovative reforestation public policy.

The idea of the "Reverse Colonization" project, designed by the Architect Fareeha Sheikh[7] in the landscape urbanism studio was developed based on the interviews, bibliographic analysis and the comparison of maps and pictures of the area throughout time. The first bibliography collected for research, about the beginning of land concessions for shrimp ponds, dates from 1975[8]. Since that moment, the Gulf of Guayaquil has been increasingly experiencing the development of the shrimp industry, being the shrimp an important source of income for the country for decades and getting to be the number one export of Ecuador in 2017 and 2018. The industry is managed through monoculture and no diversification of the land use, bringing with it the felling of mangrove and the use of metabisulfite. These two hazards can be summed up in the following lines: "mangroves as a buffer against climatic changes that affect the coastal coastline face considerable deterioration, many areas have been devastated for the construction of shrimp ponds for short-term economic purposes, with the consequent abandonment of the pools once exploited"[9].

Furthermore, "Reverse Colonization" addresses: (1) the fact that the shrimp industry uses the concession of land only for one use (monoculture), (2) there is pollution that affects the presence of fish and other resources, which consequently affects the livelihood of the communities, (3) there are socio-economic inequalities in the area; while families in the Gulf are extremely poor and depend on direct use of mangroves, particularly red mangrove[10] (Rhizophora mangle), many shrimp farms that place their product abroad make enormous benefits; in 2014 Ecuador sold to the world 2.600 million dollars of shrimp[11] (even more than banana, its classic product of export) and in 2017 the shrimp industry exported 3.037 million dollars[12]. From the public policy analysis, Ecuador counts with the Decree 1391[13] that rules that illegal occupied mangrove areas must be reforested, however there is not a detailed analysis of the effectiveness of this policy. Finally, the last idea for the design proposal is to rescue a part of the ecosystem that existed before the first land concessions to shrimp farms were given.

THE DESIGN PROPOSAL: REVERSE COLONIZATION

Given the fact that shrimp exports are an important entry of the Ecuadorian economy, "Reverse Colonization" does not propose to stop this production but to set short, medium and long term goals. The long term goal is to reforest with mangrove half of the area that nowadays correspond to shrimp ponds, or as literally written by Fareeha Sheikh "in the current scenario, the requirement is that of a balanced equation, an integrated plan where the aquaculture and the mangrove can benefit from each other and neither of the two become a hindrance in each other's progress"[14]. Mangrove gives coastal protection for communities and shrimp farms, then reforestation in the area is needed as an adaptation and mitigation measure for climate change. Reverse colonization proposes to pass through a process of mangrove reforestation and achieving smaller shrimp ponds. The design proposal is made of the following drawings:
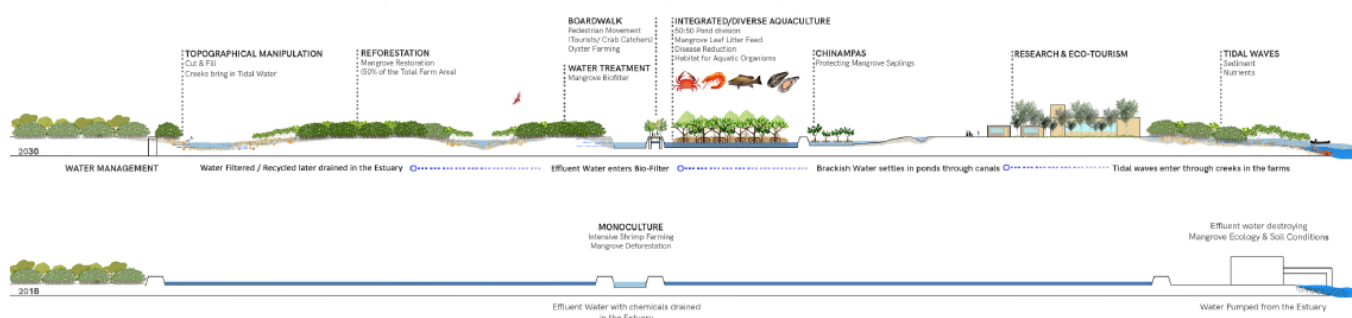
Figure 8: Mangrove and Shrimp Farm Landscape: Before and After Reverse Colonization.
Source: D´Auria, V., Peek, O., and Carofilis., N. 2018. Landscape Urbanism Studio Class
of the Master of Human Settlements 2017-2018. KU Leuven. Author: Fareeha Sheikh

As seen in the drawings, 2018 situation is characterized by monoculture and intensive shrimp farming, the use of chemicals in the water that are afterwards pumped into the Estuary, destroying mangrove ecology and altering soil conditions. "Reverse colonization" includes a set of strategies that link topographic manipulation, reforestation, water treatment, integrated/diverse aquaculture, chinampas, research centres and ecotourism activities in order to achieve the following vision for 2030[15]:

1. Starting with the process of sedimentation, if 50% footprint of every shrimp farm in the Gulf of Guayaquil turns back into mangrove through the restoration of hydrology, it means the sediment will be deposited where it needs to rest. If the major portion of the sediment that is coming with tidal waves is taken by the mangroves which right now is not the case, the Urban Frontier will undergo less topographical changes and will also be protected by a mangrove cover which will be restored by an effective and sustainable strategy.

2. By half the farm being reforested into mangrove, it becomes a biofilter. The effluent water is being treated in the farm itself and similarly its cutting down on the hazardous effects it has on the estuary.

3. The integrated ponds bring along with it the possibility of diversifying within each farm area in terms of use and produce and it helps to change the section which today is made up of monoculture and speaks loudly about extensive exploitation of the land.

4. Fish, crab, molluscs and other native species that are present in the mangrove can be farmed organically.

5. The communities have different long canoe routes to the region where they fish and catch crab for survival today in the estuary. By providing routes through the shrimp farm the dikes become more than just being a protective wall.

6. The boardwalk concept invites people in, it makes the farm a place of interaction and the spatial quality changes from being private, controlled and a secluded space to a land parcel that is public, inviting and without boundaries. The shrimp farm will be a hub for new job opportunities for coastal communities like Cerrito de los Morreños.

7. Through the Eco-tourism that will flourish on its grounds coordinated with the Research and Education Centres, which have the potential to make community participation a rigorous activity.

8. The resultant achieved, will be a mosaic that breaks free from monotony and structures the fragmented rural coastal area of the Guayas Delta by dealing with the issue of a deteriorating ecology and stitching the landscape and water by incorporating and integrating the potential of the mangrove.

This vision was developed as part of the master thesis of Fareeha Sheikh and can be a valuable input to start discussions with people from the communities who have ancestral knowledge, such as fishermen, crab collectors, women and the youth, who know their ecosystem, and with professionals from other sciences who are already working in the area, such as biologists, engineers, economists and others. It is imperative to validate assumptions and to move on to design a polished design proposal that can be implemented in real life and offer a diversity of economic activities that can contribute to sustainability in all its senses: economic, environmental and social.
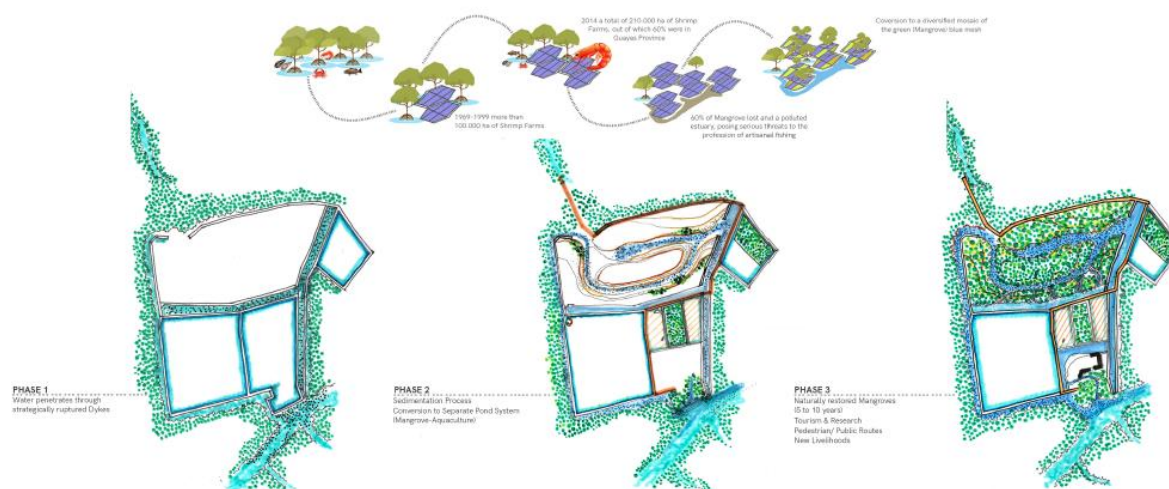
Figure 9: Short, Medium and Long Term Vision. Source: D´Auria, V., Peek, O., and Carofilis., N. 2018. Landscape Urbanism Studio Class of the Master of Human Settlements 2017-2018. KU Leuven. Author: Fareeha Sheikh.

THE PUBLIC POLICY ANALYSIS TO IMPLEMENT "REVERSE COLONIZATION": HOW AND WHERE TO START?

The vision worked from the design proposal, though potent and urgently required, is not easy to implement with no support from laws and regulations. Public policy can be an effective tool to promote changes, especially in this context since Ecuador counts with Decree 1391 that rules for

reforestation. The idea is to make feasible the design proposal with help from the public sector (how), and to visually analyse where to start the Reverse Colonization using GIS (where).
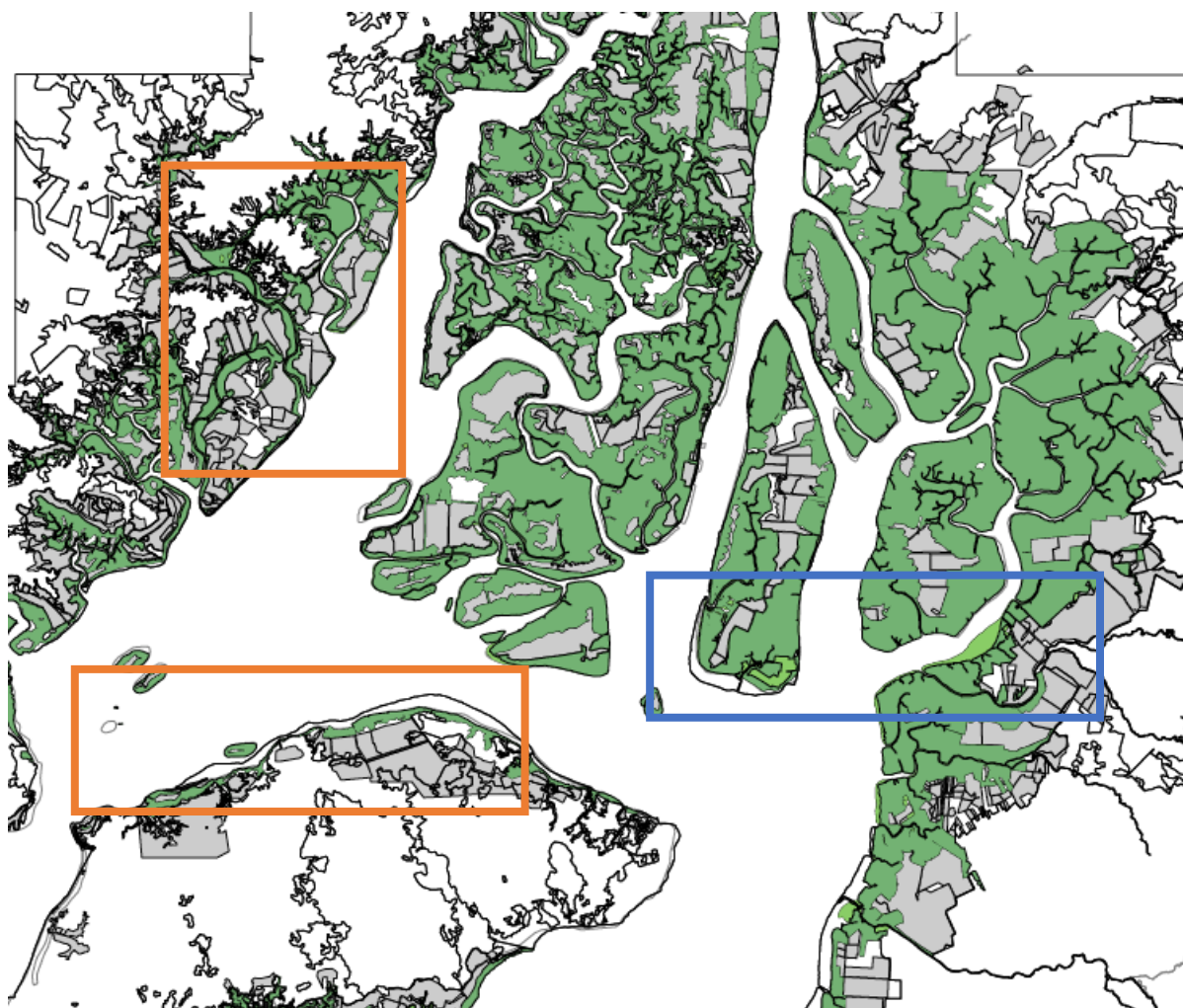
Figure 10: Close up to areas of the Gulf where shrimp farms are more in danger.
Source: "Socio-ecological conflicts and the challenge of climate change". Chávez, 2018.
(Thesis of the Master of Human Settlements).

The previous map produced in GIS with data from the Ministry of Aquaculture shows examples of shrimp farms that are highly exposed to danger because they have none or low protection, which is directly related to the presence of mangrove (orange boxes). They will be vulnerable to manifestations of climate change such as sea level rise, strong tides and high waves. In the blue box there are examples of shrimp ponds that are surrounded by a thick layer of mangrove and that consequently will have more protection against climate change manifestations. When putting together the concept of Reverse Colonization with the visual situation of the shrimp farms in the Gulf, ideas can be developed based on reality. This map can guide public policy implementation in areas where reforestation is urgently needed and where Reverse Colonization can start. It is necessary to say that biological studies are needed to validate this proposal because some factors can determine whether or not reforestation can work or can be successful in certain geographic areas.

Public policy can be used as a trigger for the first cases of Reverse Colonization. As Decree 1391 has a limited scope because is focused on reforestation only in areas that were illegally occupied, may be a good recommendation is to start changing it so it can be a more efficient legal instrument. It can regulate reforestation for shrimp farms that are in high risk or less protected by mangrove; in this way it can promote reforestation and help shrimp farmers to preserve their infrastructure. On the other hand, reverse colonization will need a change in the rules of the concessions for shrimp farms: (1) the land given in concessions will not be to use for monoculture but for diversified production, (2) the concessions given need to be adapted; a part of the land will be used for diversified production, a part will be used for mangrove reforestation, and another part will be used for activities such as research or ecotourism, and (3) waters used in the productive process needs to be treated before being pumped into the estuary.

Challenges that the implementation will face would be related to the definition of the percentages of the concessions that will be used for each part of the Reverse Colonization proposal (diversification, reforestation and research/ecotourism) and the terms of the implementation. The design proposal states 50% conversion of the shrimp farms, but the public policy needs to consider reality and short term, two concepts that are not compatible with that 50%. It is recommended that policy makers have work sessions and meetings with the shrimp sector and communities of the area to socialize this vision and make decisions about the percentages.

The fact that pollution is an issue in the analysis of the socio-ecological conflicts in the area, will present another challenge, this is because at the moment there are no measures of quality of the water or sediment of the Gulf. While the position of shrimp farmers is to repeatedly indicate they do not use metabisulfite or that they treat it well before putting the water back in the estuary, the communities notice dead fish and less fish production in certain zones that are nearby shrimp ponds[16]. At the time this paper is being written, the ESPOL (Escuela Superior Politécnica del Litoral) is implementing a program to measure the quality of water and sediment to study how this affects the species in the Gulf.

Another challenge that responds more to a socio-geographic factor is the dynamics among stakeholders in the North and the South of the Gulf; therefore, it would be more recommendable to start in the area that has less conflict. And finally, fiscal policy can also play a role, for example: using taxes for shrimp farm concessions that are not surrounded by mangrove layers or incentives for the ones that do. All these mechanisms impact directly on the stakeholders behaviour, thus and based on the methodology of randomized evaluations it is recommendable to start a pilot in certain areas, evaluate the results and then decide what kind of adaptation policies can be implemented.

CONCLUSION

This paper makes possible a mixed analysis of a proposal to solve one of the most relevant problems of Ecuador: the socio-ecological conflict between shrimp farms and communities in the area of the Gulf of Guayaquil. The design proposal is the "Reverse Colonization" prepared and drawn by the Architect Fareeha Sheikh and is analyzed from the public policy side by the author of this paper. Both works have been possible because of the Master of Human Settlements at KU Leuven, Faculty of Architecture, which allowed students from different backgrounds to analyze this topic in a holistic way. This is why this case is part of the "Education, Design and Practice" AMPS conference. Challenges that still remain are the inclusion of other disciplines such as biology and engineering that can make the proposal much more feasible and practical, validating or discarding assumptions that are proposed in this research.

To propose public policy for adaptation to climate change is not a common practice in Ecuador, therefore this proposal is avant-garde and pushes policy makers to think of all the topics that are not being discussed at the moment. It highlights the importance of changing the terms of the land concessions given to the shrimp industry, the use of GIS maps to recognize areas that are vulnerable, and to fusion design and public policy to give more accurate inputs to formulate and implement innovative and reality-based adaptation policy.

NOTES

[1] Mark Spalding et al., *World Mangrove Alias*, (The International Society for Mangrove Ecosystems, Okinawa, Japan, 1997), 101.

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[3] Rebekka Balser, *Informe Plan de Manejo para el Acuerdo de Uso Sustentable y Custodia de los Manglares del Estuario Interior Central del Golfo de Guayaquil*, (Guayaquil, 2015), 33.

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[15] Fareeha Sheikh, *Integrating Aquaculture and Mangroves,* (Master Thesis for the Urbanism Studio of the Master of Human Settlements, Leuven, 2018), 14.

[16] Wendy Chávez, Socio-ecological Conflicts and the Challenge of Climate Change: Case Study Manglares Don Goyo, Gulf of Guayaquil (Master Thesis of the Master of Human Settlements, Leuven, 2018), 176.

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HESTNES FERREIRA BETWEEN EUROPEAN TIMELESSNESS AND NORTH AMERICAN CLASSICISM

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INTRODUCTION

Raúl Hestnes Ferreira (1931-2018) belonged to the fourth generation of modern Portuguese architects who received their diploma between the 1940s and 1950s. After graduation, his experiences, studies, and surveys made him a unique character among his fellows and a key-figure to understand the national debate, particularly in the second half of the 20th century.

This article aims to emphasize the importance of staying in the United States as a student and architect, having Louis Kahn as his most excellent teacher, which was crucial to his career as an architect in Portugal.

The American experience allowed Hestnes Ferreira to understand the significance of the ancient Mediterranean culture and the extension of the idea of 'monumentality' according to Kahn's thoughts. After returning to Portugal, in 1967, this awareness was crucial to develop architecture conceived from conventional technological processes, sensitive to accessible knowledge, to place, matter, and proportion, providing to a certain extent the restoration of some social foundations of architecture.

The article, based on ongoing postdoctoral research, which aims to study Hestnes Ferreira's archive, donated to the Marques da Silva Foundation Institute (FIMS).

EUROPEAN KNOWLEDGE VS. UNITED STATES EXPERIENCE

Between 1957 and 58, Hestnes Ferreira traveled through Scandinavia, trying to understand Aalto's architecture and Nordic production. This moment was not only an opportunity to frame a possibility to overpass the crisis of the modern movement but also a chance to figure out a key for intervening in his own country. At the time, Portugal was under Salazar's dictatorship. His studies on architecture extended from the early 60s on at Pennsylvania University, where he developed a master's degree. This venture drove him to meet Kahn, whom he collaborated within Philadelphia.

His drawings, letters, models, and memories have been fundamental pieces to define a map of the theoretical bases of Portuguese architecture after the Carnation Revolution of 1974.

In Finland, Otto Meurman's Urbanism classes and those of Heikki Siren on Architecture Studio at the Finnish Institute of Technology in Helsinki were important to realize that urbanism depended not only

on the relation of buildings to one another but also on their relationship with the city as a whole, as well as it is economical and social issues.

In March 1960, Ferreira's knowledge of Finnish Architecture led to the invitation to hold a conference and the publication of an article in the magazine *Arquitectura* during the Finnish Architecture Exhibition[1]. Hestnes Ferreira refers to the importance of this exhibition as one of the few "events capable of contributing to the elucidation of a non-specialized public" to find out about the "importance of the modern architectural movement and the vast field architects have for their achievements" [2]. In the article, Hestnes Ferreira describes the atmosphere of the exhibition, where there was a recreation of a universe that suggested the Finnish landscape, as a way of understanding the nature of that architecture.

In the United States of America between February and March 1962, he attended the Department of Architecture and Urban Studies at Yale University. Ferreira attended History of Modern Architecture classes, lectured by Vincent Scully, Urbanism by Tunnard, and developed a project in Architecture Studio, with Paul Rudolf, with Woods (of the Parisian firm Candilis, Woods and Josik, former collaborators of Le Corbusier) and Wu.[3]

Then, as a student of master's in architecture Department of Architecture and Urban Studies at the University of Pennsylvania, he attended classes of Architecture Studio, directed by Louis Kahn, with the support of Norman Rice and Le Ricolais. Attended the History of Cities classes by E. A. Gutkind; Urban Structures by Holmes Perkins; Urban Sociology by Chester Rapkin; Concrete Structures by August E. Komendant and Landscaping by Georges Erwin Patton. Also attended weekly lectures by Lewis Mumford, Holmes Perkins, Mac Harg, Burle Max, Charles Eames, and Crane, among others, significantly increasing his knowledge about Urban Planning.

The previous knowledge of world history and his experience centered on Europe and the contact that Hestnes Ferreira had with the architecture of Northern Europe, in particular with Finland, Sweden and Norway, were the subject of conversation. In addition to the work done for the subject of History and Theory of Gutkind, Hestnes Ferreira translated, at his request, some texts into English about Portuguese architecture.

Architectural culture, and respect for the constructive tradition of older civilizations, was one of the reasons why Louis Kahn, invited Hestnes Ferreira, to his collaborator. During the research, in one of the many interviews I conducted with Ferreira, he confided that he considered that North American students lacked the knowledge and experience of the tradition of ancient cultures, referencing, for example, Rome and Greece. The fascination with the constructive Greek and Roman tradition was common to both architects.

During the period when he worked at Louis Kahn's office, between 1963 and 1965 in Philadelphia, he took part in projects. Like: in the Plans of the Governmental Centers of Pakistan in Dacca and Islamabad; the National Assembly Buildings in Dhaka and Islamabad; in the Main Hospital in Dhaka, as lead architect; at the College of Administration in Ahmedabad, Indian Union; and the project for the Art School in Philadelphia (not built). This astonishing academic career was decisive in his later approach when he returned to Portugal, leading him to divide his own professional practice into two areas: firstly, Architecture and secondly Physical and Urban Planning.

After returning to Portugal in 1966, Hestnes Ferreira shares some thoughts on the American city in the national magazine, *Arquitectura*, number 91, dividing the article into five points: "Conflict and Dilemma", "Dispersion and Increase of Suburban Life", "The current situation of large cities", "Needs for structural reforms for urban planning", "The city, technological evolution and location of cultural centers" and "Leisure and remodeling urban life".[4]

The following year, Hestnes Ferreira published in the same magazine, number 99, an article on "The aspects and currents of American architecture," where he demonstrates the need to adapt cities to the new experiences and demands of modern society. Reflecting on the importance of urban planning, and the intervention of sociologists, geographers, and anthropologists in the teams of designers other than planners and architects.[5]

KAHN'S IDEAS FOLLOWED BY HESTNES FERREIRA

The American experience allowed him to realize the significance of the ancient Mediterranean culture and the extension of the idea of 'monumentality' developed by Louis Kahn.

As an architect, Hestnes Ferreira investigated his own projects, which were used by himself as case studies to rehearse new typologies, material techniques, and light capacity on space definition. These architectural fundaments were essential tools for him to understand human behavior and the capacity of modern architecture in establishing connections with the legacy of the ancient past. The sense of 'monumentality' apprehended from Kahn, potentiated Ferreira's investigations about a certain sense of eternity, clearly characterized in the durability of his architecture and in its resistance to the cadence of time. Hestnes Ferreira pursued those principals through the complexity of his graphite drawings, encompassing his gestures and his own body in the same process of his projects' conceptualization.

When he returned to Portugal in 1967, this sensibility was crucial, in developing an architecture conceived from standard local technological processes, with a sense of popular knowledge, geographic implications, local materials, and building proportions, providing, in a certain sense, the restoration of some social foundations of architecture.

The design, the order, and the form are for Hestnes Ferreira, concepts that are interrelated and complementary, in the will to overcome the conceptual process. In Ferreira's works, ancestry, tectonics, and geometry are inseparable. The materials are chosen following the formal and expressive potentials of each site and integrating the value of time and the way each material behaves throughout the life expectancy of the building. By making the construction system apparent, he simplified each work, eliminating any element that may confuse its reading. Ancestry is one of the qualities of his works, originated by his interpretation of a long time.

His architectural practice was intense and can be understood by the constant triangulation between Mediterranean and Scandinavia architecture and Kahn's work, in search of the essence of architecture.

Hestnes Ferreira's first project (Fig.1), while still a student, was a single-family housing project for his father. One of Hestnes Ferreira's architectural icons. An example of the influence of Finnish architecture and the constructive Portuguese Southern tradition. With few resources, but with particular details, he obtained a consistent and timeless work.

Even today, the house belongs to the architect's family and continues to maintain its role as a meeting point for all. In the picture, we see his father, the writer José Gomes Ferreira and his wife Rosalia Castro, taken in 1961.

Figure 1. José Gomes Ferreira House, Albarraque, 1960-1961.
[credits: Marques da Silva Foundation, RHF archive]

Design| Order| Form

Both architects take the program as part of the conceptual process and argue that the architect must be able to reprogram and not merely respond to a specific program.

Kahn defined drawing as circumstantial, order as what determines appearance, and the form as something that does not exist materially, something that can be seen as a preform.

Drawing, order, and form, for Hestnes Ferreira, were concepts that interrelate and complement each other to overcome the conceptual process.
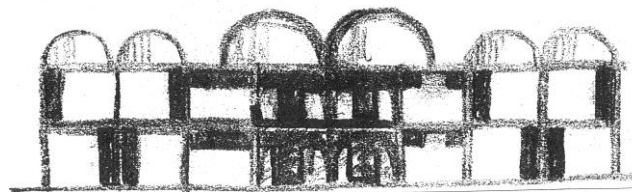
Figure 2. Ferreira sketch, Beja Youth House, Beja, 1976-1978.
[credits: Marques da Silva Foundation, RHF archive]

The Beja Youth House (Fig.2) is an iconic project in Portuguese architecture, both for its understanding and definition program, as well as the ability to capture the best of traditional architecture. Hestnes Ferreira intended to give the building a festive character, the development of this work coincided with a moment of collective euphoria, after April 25, 1974. Ferreira design this project to youth, through the creation of spaces that would provide participation and youth collaboration.

However, in this project, Hestnes Ferreira bet on the monolithic character of the building, he underlines the formal simplicity by dimension and position gave to each opening. The proposed materiality contained only traditional materials helping to simplify the final image of the building.
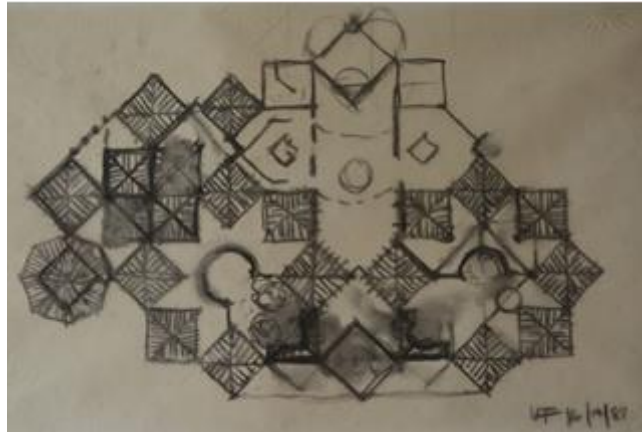
Figure 3. Ferreira sketch, Bento de Jesus Caraça Library, Moita, 1989-1997.
[credits: Marques da Silva Foundation, RHF archive]

In Bento de Jesus Caraça Library, the geometric layout is the strong point of its design. The planimetric composition of this building results from the use of the square and its repetition by rotation and symmetry, characteristic of the Mediterranean architecture. (Fig.3)

The inclusion of two patios, one attached to the adults' reading area and another in the children's reading area, underlines the constructive tradition of Southern architecture. The rhythmic repetition of the entire structure of the building helps to demarcate the different reading and service, giving the unit a unitary character. Each space is directly related to the target audience; in the way, it defines the scale of the building and the furniture.
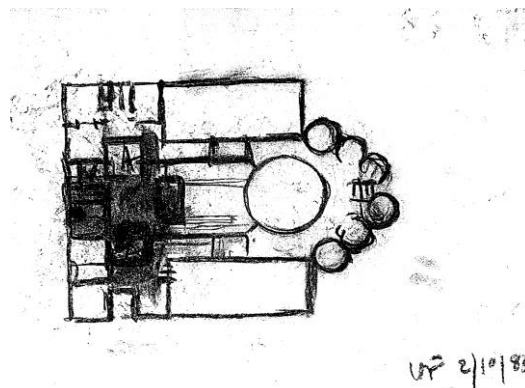
Figure 4. Ferreira sketch, Moita Court, Moita, 1988-1994.
[credits: Marques da Silva Foundation, RHF archive]

In the Moita Court (Fig.4), limiting programmatic issues, as imposed by the Portuguese Ministry of Justice, the architect maintained the same language and concepts. Ferreira's design the Library and the Court for the same location, but they were later built-in different areas in Moita and at different times.

In this work, Hestnes Ferreira opts for the use of marble for the total covering, obtaining a monolithic character.

Another of the concepts that can be associated with the conceptual program is the essence. For Hestnes Ferreira and Louis Kahn, this is a core concept of all his works. Each architectural work must be simplified, allowing to eliminate any element that may confuse its reading, to achieve its purest aspect.

Both understood design, order, and shape as part of the formal development process, where geometry and formal hierarchy allow us to define the character and essence of the project.

In the same relation defined by Kahn, Hestnes Ferreira also conditioned geometry to the use of simple figures (square, triangle, and circle), finding in his projects the elementary and clarity of the forms and relations he establishes between them, as well as the ability to hierarchize the spaces.

The use of regular geometric figures is similar. These conceptual sketches allow a close reading of the result of each building.

Dialoguing with Function

Functionalism in architecture has always been one of the points that most concerned architects, especially those of the early twentieth century.

Kahn defined the function as a direct relationship between need and used while assuming the importance of the need for space and its construction, not interfering with its definition. So, refers to "…; spaces and their consequent form as buildings should emerge from a broader interpretation of uses, but rather than the fulfillment of a specific program of functioning."[6]

Hestnes Ferreira shared this concept with Kahn and emphasized the importance of functionality, not only as of the ability of a given space to guarantee use but also by how that space can validate and influence the proposed use, with the definition of form, materials and the elements.

Figure 5. José Gomes Ferreira School, Benfica, 1976-1980.
[credits: Marques da Silva Foundation, RHF archive]

In the José Gomes Ferreira School, the ability to create "city" from an empty landscape, gives meaning to different spaces, interior and exterior, dialoguing with different functions. The cylindrical volumes balance the parallelepiped volumes topped by a rounded balustrade.

Hestnes Ferreira stated, "For me, the functionality of a space is always important; I always try to create spatial relationships in my works, accentuated by geometric and dimensional contrasts, of light, of materials."[7]

Functionality and function, when analyzed in the context of housing, are not usually changed over time. However, in the course of the modern movement, dwellings assumed the free plan as the

identifying element of the modern movement. Both Louis Kahn and Hestnes Ferreira have not identified with this movement, although they introduced and rethink spaces as a function of light, never minimize the relation between function and necessity.

The courtyard is a shared space in the history of architecture, and its use is usually associated with a central point of the building. This characteristic determines and reinforces the idea of centrality and symmetry, either formally or conceptually. Both in Kahn's work and Ferreira's work, the inclusion of courtyards, whether internal or external to the building, is recurrent.

Kahn's relationship to function does not in itself reveal functionalism since the form is neither defined nor determined by function. For us, Kahn's architecture is formalistic, the choice of form does not depend solely on function, but it is recurrent in his architecture to choose similar shapes in different projects.

Between Light and Shadow

For Kahn, the light would become a fundamental element in the creation of the architectural work - a creative element by its very nature, like a presence-creating element. There are emblematic phrases that contribute significantly to the construction of the theme of light in his work: "A building begins with Light and ends with shadows," and "The sky is the roof of a square" and "A room without natural light is not a room."

Kahn presented two conferences, the first 'Architecture: Silence and Light' was held on December 3, 1968, at the Solomon R. Guggenheim Museum, and was subsequently published in 1970 by the Guggenheim Museum, On the Future of Art[8]. So, the second conference entitled 'Silence and Light' has presented at the Architecture School of the Swiss Federal Institute of Technology in Zurich on February 12th, 1969's, and later published [9] , and it is mandatory for anyone intending to understand the binomial light and silence according to Louis Kahn.

As Alessandra Latour (2003) states, I also consider that for Louis Kahn, words had the same power as his drawings and works in conveying images about the conception of the world and philosophy.

Büttiker (1993) defined seven modeling elements (curtain; northern light, direct light, broken light, horizontal movable panels, vertical movable panels, leaf for ventilation) and the corresponding symbology in order to compare and systematize forty-nine works by Louis Kahn. This research was undoubtedly an added value for the understanding and systematization of the importance that light had for the work produced by Louis Kahn.

For Giurgola (1981), Louis Kahn's professional career is marked by a constant search for the essence of architecture through five constants repeated throughout his works. The composition and integrity of the building; respect for materials; the spatial module as the essential element, where repetition determines the design; light as a constructive factor; and the relations between the different architectural elements.

Leland M. Roth underlines the importance that Louis Kahn assigns to light 'it has the property of creating powerful, psychological responses and contains a precise psychological effect.'[10]

António Juaréz states that Louis Kahn 'associates light with a color, a predominant tonality of the reflections of the materials'[11] always taking into consideration materiality with space.

Louis Kahn's concern was defended many years later by Campo-Baeza, who considered the duality between matter and material. This search had already been felt and proclaimed by Kahn, both in his writings and conferences, as well as in his works. 'Light is matter and material (From the materiality of LIGHT).'[12]

Hestnes Ferreira also shares the same references as Louis Kahn, as in his works, the control and the presence of Light is one of the most important and significant points in his way of designing and

constructing, '..light, is fundamental; it is the spatial key of a building. Can assert that there are two types of light, one that guarantees the functionality of space, and the secret light that gives spaces, especially those most hidden, the effect of the unexpected.'[13]

Figure 6. Faculty of Pharmacy, University of Lisbon, 1979-1997.
[credits: Marques da Silva Foundation, RHF archive]

It is in the Faculty of Pharmacy project (Fig.6) that Hestnes Ferreira explores the concepts of silence and light more concretely. The different solutions result from the function proposed for each space, enabling each space of unparalleled quality and simplicity.

'Silence and Light' is a binomial created by Louis Kahn around the time of the middle of his career, and it prevailed until the end. For Kahn, the immeasurable is the force that drives the creative spirit toward the measurable, the Light. Therefore, it establishes the relation between these two concepts; silence represents what does not exist, and light represents what does.

Hestnes Ferreira never spoke explicitly regarding the concept of silence, but we can draw an analogy with the definition given by Louis Kahn. Hestnes Ferreira's architecture, characterized by homogeneous spaces, valued by light and materials. The simplicity and neutrality of spaces, realized by the absence of ornamentation and by the simplicity and clarity of shapes, determine the silence, a presence in his works. Membrane walls, light, simple shapes, scale, and materials are design strategies to achieve silence. The combination of these strategic elements determines and appeases correct acoustic enclosures, while at the same time stimulating our perception. The perception of architecture is more assertive and subtle when the senses (vision and hearing) work together in harmony.

A triad defines the nature of Hestnes Ferreira's works: the openings that receive and transmit light; the materials - decisive elements for the characterization and that have different levels of presence and express the way the buildings interact with the Place; and finally the resulting color.'[14]

CONCLUSION

Hestnes Ferreira's remarkable and vital contribution to Portuguese architecture was recognized by Coimbra University on the 30th of September 2007, when he awarded the degree of Doctor Honoris

Causa. He is an honorary member of the Portuguese Institute of Architects (2010) and owns the renowned and award-winning professional practice.

Hestnes Ferreira's architecture fits into the tradition of the Modern Movement, which emphasizes fluid spatial organization and free formal composition. It finds common ground with the design practices of the 1960s, both nationally and internationally, promoting a return to the values of history and tradition. However, along with a critical reflection on some modernist concepts, as to functionality, plastic expression, and construction. Hestnes Ferreira expresses in all his works a taste for the constructive authenticity of materials, such as Kahn. Its architecture is integrated within the geographical context, always considering the physical and cultural aspects.

FUNDING

NOTES

[1] Architects like Aalto, Meurman, Kivinen, Lindgren, Kraström, Ervi, new generation of Ahola took part in this exhibition, as well as those directly linked to the architecture school: Siren, Kraks, Tröm and Petäda

[2] Ferreira, Raúl Hestnes. "Exposição de arquitectura finlandesa na SNBA." *Arquitectura* 67 (1960): 60-61

[3] Saraiva, Alexandra. *A Influência de Louis Kahn na obra de Hestnes Ferreira*. Coruña: Universidad de Coruña, 2011: 285

[4] Ferreira, Raúl Hestnes. "Algumas reflexões sobre a cidade americana." *Arquitectura* 91 (1966): 1-8.

[5] Ferreira, Raúl Hestnes. "Aspectos e correntes actuais da arquitectura americana." *Arquitectura* 98 (1967): 148-155.

[6] Latour, Alessandra. *Louis I. Kahn. Escritos, Conferencias y Entrevistas,* El Croquis Editorial: Madrid, 2003: 78

[7] Saraiva, Alexandra. *A Influência de Louis Kahn na obra de Hestnes Ferreira*. Coruña: Universidad de Coruña, (2011): 301

[8] Latour, Alessandra. *Louis I. Kahn. Escritos, Conferencias y Entrevistas,* El Croquis Editorial: Madrid, 2003: 260-267

[9] Latour, Alessandra. *Louis I. Kahn. Escritos, Conferencias y Entrevistas,* El Croquis Editorial: Madrid, 2003: 244-257

[10] Roth, Leland M.. *Entender la Arquitectura: sus elementos, historia y significados*, Editorial Gustavo Gili, SA: Barcelona, 2005: 77

[11] Juárez, António. *El Universo imaginario de Louis I. Kahn*, Colección Arquíthesis núm. 20, Fundación Caja dos Arquitectos: Barcelona, 2006: 89

[12] Campo Baeza, Alberto. *A Ideia Construída*, Colecção Pensar Arquitectura, Caleidoscópio: Lisboa, 2004: 15

[13] Saraiva, Alexandra. *A Influência de Louis Kahn na obra de Hestnes Ferreira*. Coruña: Universidad de Coruña, 2011: 302

[14] Saraiva, Alexandra. *A Influência de Louis Kahn na obra de Hestnes Ferreira*. Coruña: Universidad de Coruña, 2011: 175

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ENGAGING TOOLS

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INTRODUCTION

Tools are extensions of organisms and, as such, are entangled with the development of the human species. Humans began with simple levers and inclined planes, allowing greater control of mass and weight. By the time of the Industrial Revolution, machinery was increasingly subjected to a design aesthetic wherein individual parts were shrouded. Where once components were exposed for understanding, and accessible to maintenance, modern technology broke away from such practices. Adding to this shrouding of parts, new and complex coded languages, programs, systems, and invisible infrastructures order the movements and components of twenty-first century tools.

This "invisible complexity" is one of the issues that inspired us as art and design educators to develop an undergraduate foundations course where art and design students, who are positioned to be the first end-users of state-of-the-art technologies, could understand more deeply the connection between hand, tool, and mind. As educators, we additionally began noticing a trend in K-12 education; over the last several years, many educational institutions dismantled or discontinued shop class programs. These programs were replaced with 3D printers, CNC routers, and laser engravers — operated by technicians. Subsequently, students are not necessarily taught how to operate these new technologies. Rather, the concentration has been towards developing virtual projects that are then handed off to a technician. Students are not educated on the limitations and possibilities of the tools actually producing their work or how the tools operate.

We posit that this lack of education on the limitations and possibilities of tools and technologies may be a contributing factor to the industry complaint that Jonathan Ive, former Chief Design Officer at Apple, stated in 2014, "So many of the designers we interview don't know how to make stuff, because workshops in design schools are expensive and computers are cheaper." He went on to say: "That's just tragic, that you can spend four years of your life studying the design of three dimensional objects and not make one."[1] In 2016, Ive added to this, saying, "I was raised with the fundamental belief that it is only when you personally work with a material with your hands, that you come to understand its true nature, its characteristics, its attributes, and I think – very importantly – its potential."[2]

This lost potential was also explored from a philosophical perspective in a 2009 book by Matthew B Crawford, Shopclass as Soulcraft, where Crawford describes in detail the necessity of manual skills and embodied knowledge for the 21st century. Crawford, however, sets up a potential false dichotomy between what he calls the "manual worker"[3] and the "knowledge worker,"[4] and does not elaborate on the potential for overlap and co-productivity of these broader categories. We feel that teaching

towards a combination of these two categories actually produces a student who is ready to engage materials, ready to encounter tools as well as new technologies we haven't even created yet. In response to these issues, we developed a course to create what we call the "manually competent knowledge worker."

FOUNDATIONS OF ART STUDIO TECHNOLOGY

This paper examines the development and implementation of our course, Foundations of Art Studio Technologies (hereafter referred to as FAST), and our approach for creating an environment where students understand the physical, historical, and philosophical relationships between tools; can operate and discern the components of tools and begin to create a foundation to become a manually competent knowledge worker. We will describe a historical basis for the course, mysterious "black boxes," concepts in empowerment-in-use or agency, and the importance of *making* and *touching* for the FAST course as we have developed it.

A Historical Basis

We developed the FAST course to bring up to date many disparate but related historical methodologies for teaching tool use. The philosophical and structural basis for the course relies on our own personal experience using tools in real world applications for art, design, construction, and manufacturing. We also used our research into the origins of human created tools, and how the proper use of tools, along with the most effective methods for fostering innovation have been passed from generation to generation.

Human tool use and human societies developed in tandem, as described by Kwang Hyun Ko in Origins of Human Intelligence: The Chain of Tool-Making and Brain Evolution. He states that: "Biologically, the hominid brain reorganized its functions away from visual processing, which is essential for survival in the wild, and more towards other functional areas, such as planned movements, cognition, and language, which are crucial from increased sociality and tool-making. In turn, the evolution of the brain would drive stone tool technologies even further."[5] The ability to plan movements, have advanced cognition, and communicate those movements and cognitive activities to others allows humans to progress from simple tools towards the complex tools of the Industrial Revolution and today.

Along with the Industrial Revolution, teaching tools and their use moved towards formal educational programming called the industrial arts. One of the original motives for Industrial Arts was as a basis for a liberal arts education that would lead to further training. This was described by Gladden in 1885, (and sorry for the gendered language): "There is an industrial training which is neither technical nor professional, which is calculated to make better men and better citizens of the pupils, no matter what calling they may afterward follow; which affects directly, and in a salutary manner, the mind and character of the pupil, and which will be of constant service to him through all his life, whether he be wage worker or trader, teacher or clergyman. The training of the eye and of the hand are important and essential elements in all good education."[6] This training was originally designed for both men and women equally, but there was a bifurcation between art and science, as well as an emerging desire to train for specific skills.[7] The training then became increasingly more vocational, which eventually led to a gendered split of industrial arts and home economics.[8] The lack of diverse voices in addition to an unwillingness to transform the curriculum led to the downfall of the industrial arts education in high schools.[9]

Black Boxes

This history leads us to our 21st century tools, where machinery and technology are being increasingly subjected to a design aesthetic, wherein individual parts are shrouded and smoothed[10]. We call this shrouding a "black box", defined as a device, system or object that can be viewed in terms of its inputs and outputs without any knowledge of its internal workings. Its implementation is "opaque."

We encounter these "black boxes" in our everyday lives, and when even one component fails, the entire device becomes useless. This is compounded by the impenetrable design, planned obsolescence, and proprietary construction of such tools. Through readings assigned in the FAST course, such as a 2011 paper by Cristiano Storni, students begin to learn the complexity of design systems. In Storni's paper "The Problem of De-Sign as Conjuring: Empowerment-in-Use and the Politics of Seams," he writes: "By removing the sign from their design, the designer re-affirms their authority toward a mass of passive users who can simply attend to what is performed on stage, unable to access or perhaps even conceive of what lies behind it."[11]

In the FAST course, students develop a foundation for understanding themselves as "tool-users". This is further expanded and developed by examining not only how a tool operates but how tools are put together — we tear apart tools, we expose all of their components and call them out for what they are, and we emphasize how they are structured similarly to other tools. Fundamentally, students begin to understand the intricately layered systems contained in the history, construction, and use of complex tools. Students are afforded the opportunity of empowerment-in-use through a deeper understanding of the tools and technologies they are using by the process of making. We theorize that once a student has a more complete knowledge of the tools and technologies in front of them, they are more confident and inspired to use them and potentially subvert them, and in turn open spaces for innovation. This is further emphasized through a series of other readings assigned to students that speak to the philosophy of tool-use, handling materials and technologies. Martin Heidegger states: "The nearest kind of association is not mere perceptual cognition, but, rather, a handling, using, and taking care of things which has its own kind of knowledge."[12] The assigned philosophical readings by Matthew B. Crawford, Alva Noë, and Cristiano Storni serve as the basis for a reflective writing assignment that students compose over the course of the semester. Through this writing, students begin to flesh out deeper connections and systems of tools and technologies they handle during the process of making.

CONCEPTUAL OVERVIEW OF FAST

FAST is an undergraduate foundations course where the demystification of technological devices reveals technical knowledge as systems of organization, and where students are tasked to find potential malleability within these accepted organizations through manipulation of tools and materials. Essentially, when students begin to understand "systems" for both their components and their entirety, they can begin to examine other systems, such as political, sociological, and physiological systems, and identify them as similarly malleable systems instead of disparate concrete institutions.

In the class, we dissect tools down to their essential components, while asking students to determine each tool's limitations and potential, and to critically consider the generated outputs these tools and technologies produce. This consideration builds through identification, observation, and play, as well as a philosophical understanding of the history, the structures, and the politics of tools. This foundation equips first-year students with the ability to encounter tools they do not know, to engage, master, and even subvert tool use.

Course Structure

The FAST class approaches the teaching of tools in a unique way for an art and design curriculum. The course, designed for first-year art and design students, covers everything from screwdrivers, stationary power tools, welding, and CNC technologies. We work up to more complex technologies as the course progresses, all the while asking students to consider ways in which simple tools comprise our complex modern tools. In addition to being a requirement for art students, FAST is also a General Education course, so students from any discipline can take it. We have taught engineering, occupational therapy, biology, and various other humanities students in the course. Critically, the Bioengineering department at our university is in the process of requiring this art course for all of their students. We hope that this initiative will be copied by other departments and colleges at our university in the future.

A key benefit of the course is to create "Access through Identification" and "Safety Training." One of our credos while teaching the class is: Identification and Safety equals Access. We see this as not only access to the tools in the art department, but immediate access to all of the facilities, including the technicians in the department. Without this wide introduction to an understanding of the location of tools and who to talk to for instructions on their use, as well as a basic understanding of safety, students would otherwise only gain exposure to these spaces over a period of up to two years. We want them to be aware of their entire work environment as soon as possible, so they can start using all our facilities, and then create and innovate.

Teaching A Tool

To put these theories in motion, we will describe the methods used to teach one tool from the course, the laser engraver. Students are introduced to the laser engraver on a tour of the department's facilities on the first day of class, but later on in the semester when we teach it to them, students walk in to see the laser engraver taken almost completely apart, now open for visual analysis. This disassembly is a way to demystify the tool and its workings. We allow the students to identify the fundamental components of the tool, building an initial familiarity with the laser, and as they piece together the complex interactions of these components, we reassemble the tool. After reassembly, we turn on the laser engraver and identify the functions of the user interface, which allows students to directly understand the changes that their physical inputs will have on the device.

After covering the physical tool, we show them the software used to run the laser engraver, Corel Draw. At this point in the course, students have already gained access to the Adobe Creative Suite and we point out that almost all of the virtual tools in Corel have analogs in the programs they already understand. This forms a second layer of familiarity with the laser and allows us to immediately demonstrate the use of the laser while highlighting the specific safety considerations, and unique characteristics of our particular machine.

Students are then tasked with operating the machine, and to work as a group to make sure they are operating the machine correctly and safely. Once the entire class has used the machine and has in effect gained access to the machine through safe use and identification of components and operational procedures, we assign the students a "testing out" where they demonstrate their ability to properly use the tool, comprehend the information that was presented to them, and—importantly—they use the tool to create tools for their own use.

The "testing out" requires students to cut out pieces of wood with the laser, and then assemble them into personalized measuring tools. This requires students to return to many tools already covered in the course, and to reinforce the connections between different tools, and the reasons for using specific

tools for specific tasks. The consideration of which tool to use for a particular problem forces students to consider what makes a tool useful, and where that tool fits in a broader system of tools.

Tool Use As Systems Thinking

The skills gained through this course lead to a student's ability to use systems thinking. The teaching of interwoven component layers on the laser engraver is reiterated when we visit the CNC Router and the 3D printers. We describe to the students how these tools are essentially using layers of abstraction to create objects and to do work. We have borrowed the term abstraction from computer science, where it describes the layers of distance from which the user works; from the fundamental electrical signals, to the binary representations of those signals, which are then layered underneath language driven coded representations, all operating underneath our user interface at the operating system level. We think that in the same way that computation is abstracted, human tool interaction becomes abstracted. If we start with thoughts equaling electrical signals as the first inputs, the "binary representation" is equivalent to the full body control afforded to a human by a hand held tool, which we term the full control of "code". When machines add tables and fences that constrain directions of work, while adding precision and consistency, we talk about a "translation of code," from the human to the machine, which is similar to the constraints set up by coding languages in computational systems. The final "translation of code" happens when tools are fully pre-programmed by the user, and are set up to perform ultra-precise, and potentially repetitive tasks, wherein the user only observes a process while the material is being worked.

We extend this understanding of repetitive tool use into the material world, and ask the students combine small parts to create a larger whole. While testing out on the laser engraver, students each make seven identical interlocking wood components, and at the end of the assessment, they combine the components into a large structure that eclipses the size constraints, or "bed size," of the tools that made the components. Students are then able to understand that even the physical constraints of a machine are available for subversion.

SUMMARY

The understanding of the layers of abstraction, and the translation of "code" for inputs, as well as the peeling back of the machine shrouding, which removes the fear of a black box, empowers students to know that they can understand machines and manipulate their output, if only they break them down into the simple tools that we introduced at the beginning of the course. Again, it is the precise application of a combination of identification and safety training which equal access for our students.

This newly developed "access" can aid students in the other foundations and upper-level courses at the University of Toledo. Educationally and philosophically, FAST provides incoming students not only access to understanding tools and technologies, but also the critical thinking skills and insights into multiple types of organizational systems that currently support design, technology-utilization, and human interactions. Additionally, our experience has shown that as students move into their upper level courses after successfully completing FAST, many faculty can adjust their course schedules to focus on finer or more advanced techniques, historical connections, actual 'making', and an ability to explore conceptual components of their curriculum, rather than setting aside large blocks of time dedicated to tool use and safety. Subsequently, our other foundations and upper level courses help students pursue a mastery of tools as well as the ideas, philosophies, and systems presented in FAST at an accelerated rate.

We hope to develop the course further, and to analyze the outcomes from the course over a longer period of time to gain a better understanding of the impact this course is making. We are constantly

evaluating the tools and technologies that we include in the course, because the course is not designed around the specifics of the tools, rather, this course is designed around the evolution of human organisms, and the ways in which our constructed extensions, otherwise known as tools, organize us.[13]

NOTES

[1] Anna Winston, "Design education is 'tragic' says Jonathan Ive," *Dezeen,* November 13, 2014, https://www.dezeen.com/2014/11/13/design-education-tragic-says-jonathan-ive-apple/.

[2] Dan Howarth,"'Fewer designers seem to be interested in how something is actually made' says Jonathan Ive," *Dezeen*, May 3, 2016, https://www.dezeen.com/2016/05/03/fewer-designers-interested-in-how-something-is-made-jonathan-ive-apple-manus-x-machina/.

[3] Crawford, Matthew, *Shop Class as Soulcraft: An Inquiry Into the Value of Work*, (New York: Penguin, 2010), v., 20–21.

[4] Ibid, 1,5, 9, 44, 47, 130, 138, 143, 144

[5] Kwang Hyun Ko, "Origins of Human Intelligence: The Chain of Tool-making and Brain Evolution," *Anthropological Notebooks* 22, 1 (2016): 12. Accessed August 18, 2018. https://www.researchgate.net/publication/305991971_Origins_of_human_intelligence_The_chain_of_tool-making_and_brain_evolution

[6] Karen F. Zuga "Reclaiming the Voices of Female and Elementary School Educators in Technology Education," *Journal of Industrial Teacher Education* 33,3 (1996) Accessed January 11, 2017 https://scholar.lib.vt.edu/ejournals/JITE/v33n3/zuga.html.

[7] Ibid.

[8] Ibid.

[9] Ibid.

[10] Byung-Chul Han, *Saving Beauty*, (Medford: Polity Press, 2019), 1–9.

[11] Cristiano Storni, "The problem of de-sign as conjuring: empowerment-in-use and the politics of seams," *Proceedings of the 13th Participatory Design Conference: Research Papers - Volume 1 (PDC '14)* 1 (2014): 164, accessed August 14, 2018, doi: 10.1145/2661435.2661436.

[12] Martin Heidegger, *Being and Time*, trans. Joan Stambaugh (Albany: SUNY Press, 1996), I.iii.15, p. 63.

[13] Alva Noë, *Strange Tools*, (New York: Hill and Wang, 2015), 18.

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USING DESIGN COMPETITION CALLS IN A "DESIGN STUDIO" COURSE

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INTRODUCTION

"If architectural education could have one clear goal it should be to educate and sustain the next generation of talent to have a sympathetic awareness of its origins"(Weiner 2003)

The design studio course, which has its roots from the *Ecole des Beaux-Arts* in Paris, is still a primary source of education in architecture and composes the backbone of the curricula (Smith 2016). The studio-based learning model is in the center of interest for scholars (Schön 1986, Dutton 1987, Ibrahim and Utaberta 2012, Negar Kalantar and Borhani 2016, Pasin 2017, Ashraf M. 2017). Considering the current changes in society and that variations in the teaching of architecture are arising with those changes, the role of higher education faces numerous complex pedagogical and professional barriers.

Taking into account the impact that buildings have on the environment –on overall, the buildings sector is responsible for up to 40% of the total energy demand (EEA 2017)– and the growing ecological awareness required by new regulations concerned with the construction sector, e.g. the European Commission's Green Paper (Commission of the European Community 1990, 2007), the role of higher education to the principles and practices of sustainable environmental design is becoming highly significant (Altomonte 2009).

In practice, architects need to navigate a myriad of regulations to answer to environmental, economic and social needs. The calls for an architectural design competition –which are in the core of both civic buildings and public space projects– are designed according to a set of national and European regulations in order to ensure sustainable architectural qualities (Kreiner 2009). The roots of the design competition –like the design studio course– date back to a long architectural practice history. The relevance of the design competition is acknowledged worldwide and has several targets from disclosing new talent to gain insight in competences. Competition is considered as an essential design tool which enhances a certain level of architectural quality trough jury assessment and enables a fruitful architectural debate (Volker 2010).

Thus, globalization, climate change and technological design tools improvement transformed the profession and its education system. Taking into consideration historical education and practice development, we argue as Buckminster Fuller (1963) that the architectural is a bi-modal profession, formulated both by the world of art and technical performance. The studio-based model learning in architecture is needed in order to enable students to acquire critical thinking while understanding the

design process instead of focusing on the final product. Moreover, the atelier should initiate training building practitioners, which supports the successful implementation of environmental considerations −including bioclimatic design strategies, choice of materials, construction techniques, passive heating and cooling strategies and resource efficiency−.

Taking the faculty of engineering of Brussels as a case study, this study investigates the theoretical bases and practical challenges of knowledge in the design studio trough the design competition exercise in the atelier.

This article follows a case study research methodology by conducting a questionnaire survey with the students of two academic years in the third bachelor (third year of study).

The research intends to answer the following question: what kind of projects should we design for students in architecture in order to integrate social, environmental and economic changes into the process of "learning by doing", while at the same time valorizing the knowledge acquired in the curriculum?

The first section provides an empirical literature review on the design studio and design competition in architecture. Based on comparative analyses of the survey data, the third section discusses what sort of knowledge can be observed in the faculty of engineering in design studio course after having presented the research methodology in the second section.

This study further aims to draw guidelines for alternative disciplinary structures for the future of architectural education, within which various theoretical and technical expertise on design are cross related with practical mental skills.

EMPIRICAL LITERATURE REVIEW

Historically, scholars highlight four main models of architectural skills acquisition, which are interrelated without any fixed boundaries between them (Ján Legény, Špaček, and Morgenstein 2018). The necessary skills acquisition that a student should attain in architecture is the "learning by watching". Indeed, the building has its embedded curriculum, which can significantly influence and affect the learning process. The architect Tadao Ando, for instance, stressed out the importance that the relationship of design process might have at both the design studio and the outdoor environment (N. A. G Abdullah et al. 2011). Because learning to design constitutes a curious predicament for education −since students face difficulties to understanding what do they have to learn−, the atelier has to be seen as the learning place where students can educate by themselves by beginning to do it (Schön 1986). Thus, in order to "do it", working by imitating is an essential component in architectural skills acquisition, which require links with the other educational courses. Hence, the need for the learning by watching, doing and imitating skills to be taught and experimented in order to enable students to acquire a:

- critical design −architects have to be conscious of the context in which they operate;
- critical thinking −this is the part of subjectivity and alternative forms of knowledge (Brenner 2009);
- networked learning pedagogy −which allows students to incorporate the necessary collaboration skills (Maii Emam 2019).

Thus, the design has its way of knowledge production −thinking and acting−, which is never neutral. Design is shaped by the society and the system in which it is developed. Thus, design education in architecture has to provide transferable knowledge which should be worthwhile, taking into consideration that students learn not merely by accumulating knowledge but through an ongoing process of 'trial-and-error' (Newton C. and Pak B. 2015). Despite the interest of using a design

studio- based learning process in the center of the architectural education, this model has certain limitations which can directly have an impact on the students and their professional future. We highlighted five major concerns related to the design studio model from scholars (Dutton 1987, Boyer and Mitgang 1996, Webster 2006, Newton and Boie 2011, Newton C. and Pak B. 2015, Masdéu and Fuses 2017):

1. the focus of the studio is still primarily on the final product rather than on the process;
2. the atelier is still poisoned by an overemphasis on the teacher, which can limit learning;
3. the learning activities do not take place in the real professional environment, and there is often a lack of connection with the professional practice despite the collaborations with specialists;
4. the current emphasis on the design product, together with the emphasis on moments of critique, stress out students who have to be judged by their teachers;
5. students can be subjected to isolation in the studio.

Thus, despite changes that are occurring in the profession, the training of architects continues to focus on educational models that are more and more distanced from the professional concerns. Overall, without questioning the usefulness of the studio in architectural learning curricula, we argue that it is essential to build a design studio program around an open and participatory process. Hence, the interest of using real design competition calls in the design studio course. Its contributions to learning are multiple. The design competitions are a unique opportunity in architecture design studio courses (Kreiner 2009, Gottschling 2017) to:

- supply material for students' portfolio;
- build up a common repository of guidelines (e.g. safety, disabled access…);
- challenge architects and students to work together on complex integrated projects;
- develop skills in architectural argumentation and communication;
- develop collaboration.

However, design competition calls are facing some limitations that have to be addressed for pedagogical purposes. As design competition weaknesses, we can first highlight the specifications that are often vague and not precise enough and, second, the assessment criteria that are difficult to quantify.

To sum up, we conceptualized our understanding of the complementarity between practice (focused on design competition) and education (focused on design studio) in Figure 5**Error! Reference source not found.**. We learnt from our literature review analysis that building a networked learning for critical design thinking requires the complementarity between the action of learning, sharing, giving and receiving. This quadruple system of actions is always in the center of the creative process for practice and education in architecture.
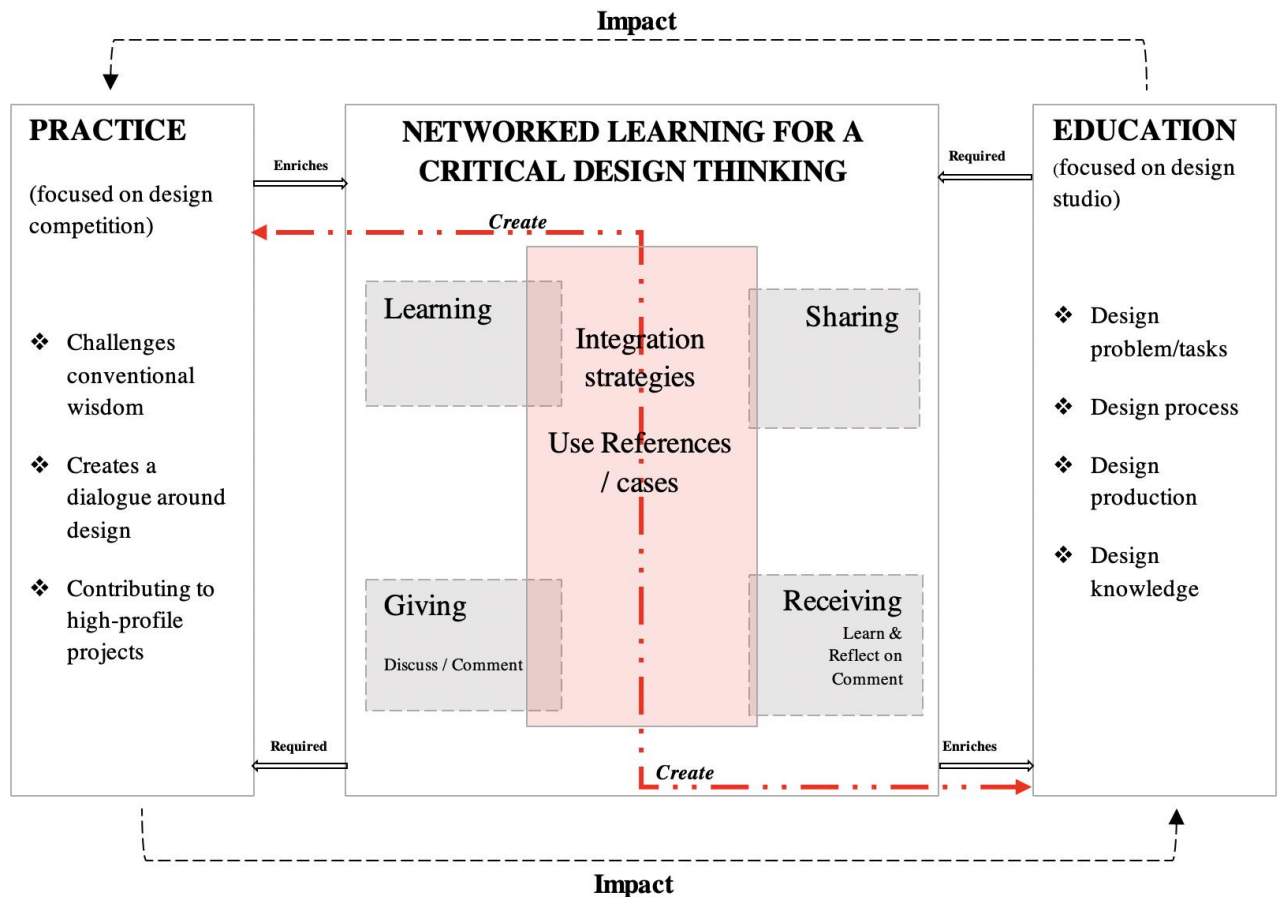
Figure 5 Model of linking practice and education (authors)

METHODOLOGY / DESIGN OF THE STUDENT SURVEY

At the faculty of engineering of Brussels, courses are run on a semester basis. The design studio is taught in five academic sessions (first year to fifth year). It is a course that runs through both semesters of the academic session. The department appoints mentors, and they guide and teach the students. The design studio is grouped into one module. The class has three instructors. A student is expected to complete the module at the end of the year.

For the last three years, the BA3 architecture design studio has been working on the implementation of a teaching program that allows the articulating of both the architectural composition and mastery of work for the design of contemporary public equipment integrated into a particular urban context. The program of the studio proposed to students of civil architectural engineering is organized around responses to design competition open to professionals. Using the design competition as a teaching tool, we intend to train students to respond to a program and to specifications imposed by a design competition. The interest of working based on architectural competitions lies in the learning, respecting and managing complex programmatic information. Students must meet functional, normative, structural and urban requirements while leaving room for their creativity and architectural sensitivity.

Our teaching objective is located at the intersection between the societal concerns and the professional demands (Figure 6).
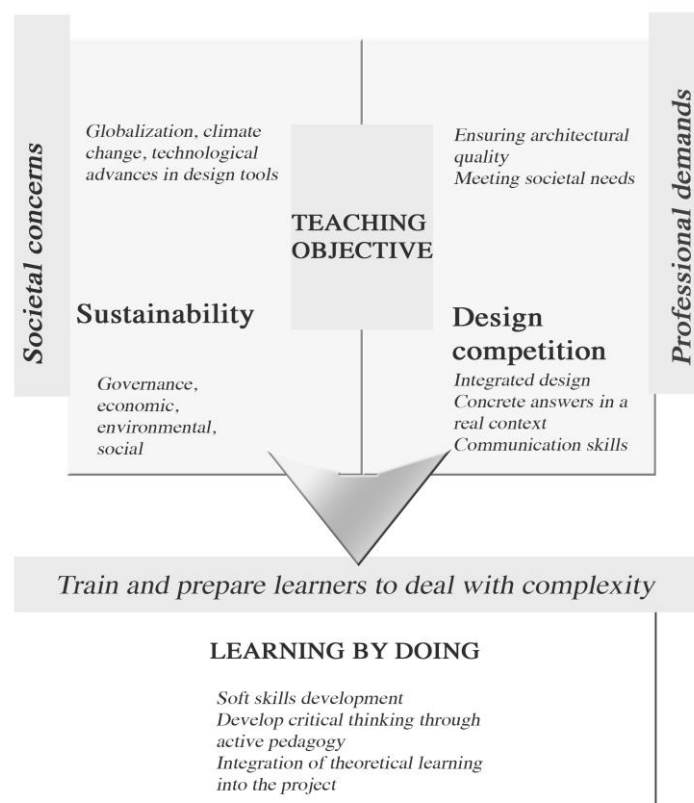
Figure 6 Objectives of learning in our BA3 design studio course (authors)

Likewise, for a professional design competition, intervention by external experts in our studio is essential in order to encourage students to integrate experts' points of view into their project. Moreover, the composition of the jury, with members from multiple disciplines, engage students with different professionals who are also participating in the same design competition and help develop their critical thinking and critical design. The use of design competition calls is also supported in our studio by a self-evaluation, which aims to encourages students to focus on the design process as much as on the final object and develop a collaborative strategy. Thus, the peer evaluation encourages students to reflect on the learning and design processes. Furthermore, in order to ensure their ability to translate physical laws in creative architectural forms as Yannas (2005) suggests, the integration of theoretical learning is an essential requirement to develop a common repository accessible to students in their future practice.

Finally, the design competition calls are omnipresent in the architectural practice and can be very important for young architects' recognition (Kazemian and Rönn 2009, Kreiner 2009). Thus, we think that respecting the design competition rules trains students to develop a better understanding of the public market. Indeed, answering to a real design competition has multiple benefits for the students, ranking from the development of argumentation and composition skills, to the improvement of drawing communication and technical knowledge and the implementation of environmental design as a creative factor in the practice of architecture.

Based on these teaching learning objectives, we elaborated over a time frame of 2 years a survey analysis using anonymous questionnaires (n= 8 to 16) and a semi-structured interview (n=8) that are discussed and detailed in the following section. The initial questionnaire is divided into two sections; experience questions, which ask the students to assess their interests on the solutions implemented in

the studio from 1 to 5 (1 = the lowest interest / 5 = the highest interest). The second section consists of open-ended questions about how the studio met their expectations. The answers of questionnaires mean to help in evaluating the studio and assist in applying any required modifications.

RESULTS AND DISCUSSIONS

The initial questionnaire was answered by 16 students. On the other hand, the 9 new questions were integrated in the final questionnaires and were answered by 8 students. Both questionnaires were anonymous. Students were asked open-ended questions in both questionnaires. They were asked to give their opinion about environmental, communication, and technical skills development. Their answers were coded into factors and the results shows that taking design competition calls as the basis of our design studio course allows students to first, understanding and complying with the professional requirements for an integrated design project: the public market, the complexity and constraints of the urban context, the evaluation process, the divergence of points of view between the experts. Second, develop of soft skills like communication, developing arguments, prioritizing tasks and teamwork. Third, build a common repository and develop architectural and technical skills as well as critical thinking. Fourth, integrate societal concerns for a design that is respectful of the environment.

At the initial questionnaire, students were asked to rate their studio experiences on a scale from 1 to 5. After analyzing the data of the questionnaires, it was found that the answers to the benefits of understanding the complexity of the public market showed similar results than in the open-ended questions with slight changes (Figure 7). In the other hand, results show the need for major changes in some factors: the self-assessment sheet; the workload and time frames. These weaknesses of using design competition calls in the studio were also emphasized in the semi-structured interviews were students expressed their concerns about the tight schedule of the design competition coupled with their tight theoretical courses schedule that composed their curricula.

Moreover, when students were asked if joining the peer evaluation panel developed their critical perspectives and encouraged interaction, only 50% of the students are agreed with this affirmation while 25% are undecided, giving a score of 3 out of 5.

The final questionnaire also measured how participants conceived the integration of the sustainability component in their project (Figure 8). Although the sustainability component and environmental concerns came fourth in the open-ended questions about ranking skills development, both in the structured interview and questionnaires 75% of the students agree on the interest of using real design competition calls in the design studio to develop their knowledge on this specific field.
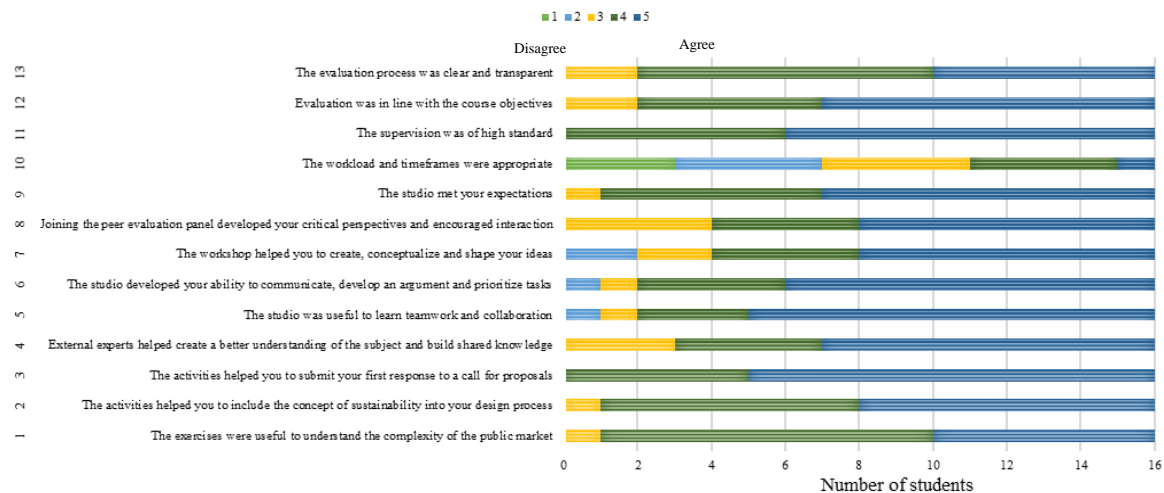
Figure 7 Benefits of solutions implemented in the studio in initial questionnaires
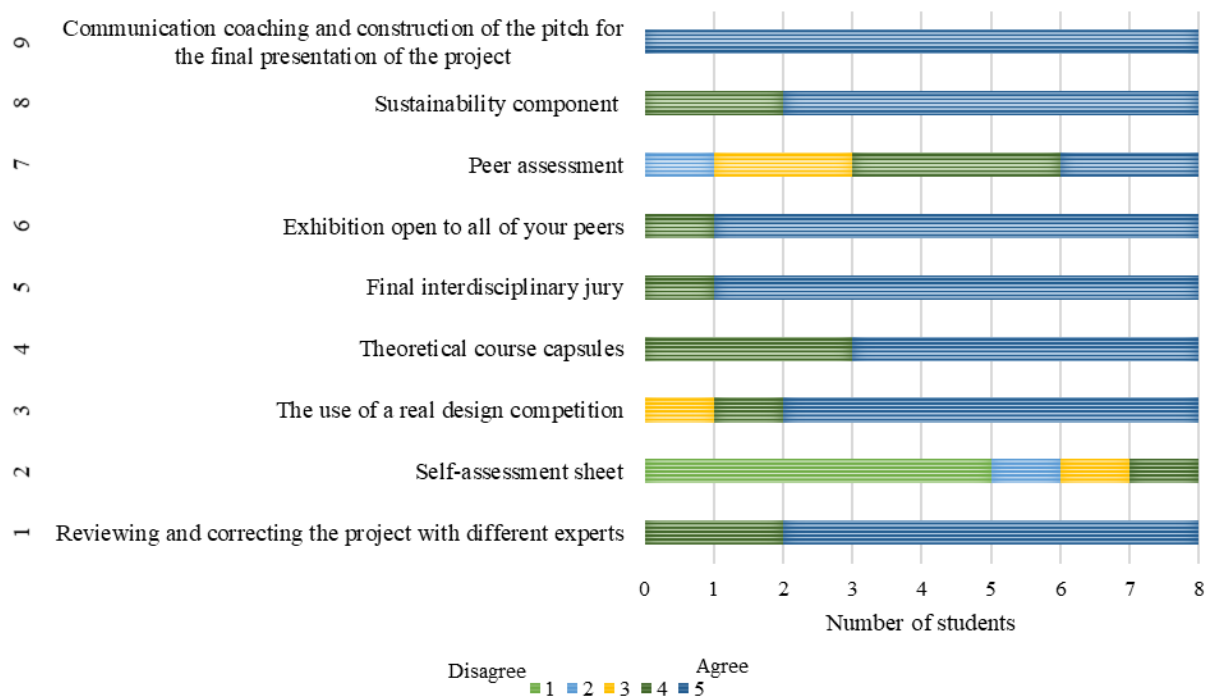
Figure 8 Benefits of new additional solutions implemented in the second year of the studio

CONCLUSION

We can conclude from the previous data analysis that taking the time to understand the design competition call allows students to analyze a specific problem, instead of requiring proposing first a solution. Thus, students are less focused on the achievement of a desired result rather than to a critical investigation of the complexity of the problem they face.

Therefore, we will continue to use real design competition programs as a base for the design studio course, since the students' feedback was in general positive with some points of attention. Indeed,

with the solutions implemented in our studio, we managed to address the previous problems of the design studio highlighted in the literature review. Table 1 gives an overview of these results.

SOLUTIONS implemented in our studio	ADDRESSING THE PROBLEMS of design studio courses				
	Focusing on the process rather than just the final product	Distributing learning away from the teacher	Linking with professional practice	Encouraging collaboration	Dealing with the complexity of the public market
1 Intervention by external experts	X	X	X	X	
2 Self-evaluation	X				
3 Respecting the design competition rules			X	X	X
4 Training in graphic and oral communication					X
5 Jury members from multiple disciplines		X		X	
6 Exhibition				X	
7 Peer evaluation	X	X			
8 Environmental awareness embedded in the project			X		X
9 Integration of theoretical learning	X	X			X

Table 1 Relationship between solutions implemented in the BA3 studio and the design studio course problems highlighted in the literature review

To sum up, and to further develop this study on using design competition calls in a "design studio" course, it would be interesting to study the impact of the students work on the final winning project of the design competition. Although we couldn't further investigate this element, our collaboration with local authorities and design competition holders was very beneficial. The students' work inspired the client and the local authorities. Moreover, we observed a positive influence on other years of the

curricula of our faculty and a better cohesion within the group of students we worked with. The strengthening of the visibility of the student's projects outside the faculty gave a professional credibility to the students training, which tends to encourage them in the continuation of their courses.

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DISCIPLINARY TRANSGRESSIONS: DENATURALIZING KNOWLEDGE COMPARTMENTALIZATION TO RETHINK URBAN LOW-INCOME HOUSING[1]

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INTRODUCTION

At the same time that the teaching practices in universities demand the updating of their methodologies and contents to a world that is already fully immersed in the 21st century, interconnecting and computerizing itself at an impressive speed, higher education still has the challenge of facing problems that emerged in the 19th century. In cities, especially in countries of the so-called Global South, problems related to health, housing, education and mobility, among others, persist.

Many of the solutions adopted for these problems throughout the 20th century were not enough to overcome the scale and complexity of the challenges presented. This points out to the need to rethink our roles under other methodological and even epistemological perspectives in order to seek alternative ways to solve these complex issues. Thus, from the perspective of urban-housing problems in the peripheries of the Global South, we understand that we cannot afford to waste human and material resources by teaching and learning in ways that are not suited to the local reality and therefore will not effectively address the existing problems.

From this perspective, we aim to debate the need to transform the way we teach and learn architecture, urbanism and landscape architecture, particularly in the context of low-income areas such as those of Brazilian large cities. From practical experiences in dialogue with interdisciplinary and heterodox theories, we discuss the incompatibility of compartmentalized curricular structures and the fragmentation between planning, designing and building.

Several authors have contributed to our reflections throughout the process of finding our place in the universe of teaching-learning and practicing architecture-urbanism-landscape, as well as looking for answers to the practical problems that both exist and emerge from the field practice. In this context, we believe that we should discuss the very idea of the university itself, restructuring it and rethinking it in the terms of the complex issues of the contemporary world. The university should be constructed in order to deal with the needs and wishes of the society and not act according to the interests of profit-oriented organizations. In order to achieve that, we need to rethink certain technical-scientific values from alternative epistemologies and points of view.[2]

The transdisciplinary approach to architecture takes into account the international[3] debates that seek to deepen knowledge about praxis which respect local particularities. Those are combined with theoretical dialogues that aim to interpret social practices[4]. Freire's[5] pedagogical thinking, which highlights the need for consideration of the learner's reality in the pedagogical methodology, is linked to the importance of the multi-dimensionality of architecture-urbanism-landscape. This points out to the understanding that these disciplines need to be connected to the understanding and learning environment in the real-life context.[6]

With this theoretical-methodological matrix, open to other influences, we set out for a series of experiences with curricular disciplines held in a self-organized squatter settlement called Solano Trindade. It is part of a work that has been developed since 2014 by the National Movement for Housing Struggle – MNLM –in partnership with Federal University of Rio de Janeiro – UFRJ. We describe this experience, focusing specially on a workshop held in March 2018. The workshop was the main part of a Summer School, and was the result of the collaboration between the Postgraduate Program in Urbanism - PROURB/UFRJ and the Landscape Architecture Department of Technical University of Berlin - TU-B. We discuss the limitations, challenges and potentialities that permeate the relationship between university and society.

THE WORK WITH THE SOLANO TRINDADE SQUAT

In 2014, a group of people associated through the National Movement for Housing Struggle (MNLM) and with support from the Metropolis Observatory of IPPUR and NIDES, both research groups from UFRJ (Federal University of Rio de Janeiro), occupied an area of land that had been vacant for more than 10 years, naming it Solano Trindade Squat. Before this land was abandoned, it had been used by the Pan American Foot-and-Mouth Disease Institute, as a concession of the Colonization and Agrarian Reform National Institute (INCRA). The Pan-American Institute still works in part of the land, but the area where Solano Trindade has been located since 2014was partially decommissioned and abandoned years ago.

Since then, a partnership between UFRJ and the Solano Trindade Squat in Duque de Caxias, Rio de Janeiro, has been developed. Through the Metropolis Observatory and NIDES, the social movement MNLM approached the research group [na]MORAR, which was asked to provide technical support in order to meet the architecture and urban design solutions requested from the squat by The Federal Heritage Secretariat (SPU).

This squat, in accordance to the MNLM principles, acts in order to not only provide housing to people who do not have access to it, but mainly to reinforce the right to housing and the State's responsibility to make sure that the social function of property – both part of Brazilian Constitution – are guaranteed. Their perspective was the construction of new housing for low-income population - 0 to 3 minimum wages -, as well as the refurbishment of some of the existing buildings on the land. Besides that, the movement advocates for the need to integrate the supply of housing and effective actions to generate income and employment. Therefore, in the foundation of the architectural project there was the need for space for economic and educational activities.

Our way to support MNLM was working in curricular disciplines and extension activities inside the university, which led us to a series of findings regarding the inadequacy of the curricular structure and the demands of the undergraduate course of Architecture and Urbanism. Although we had previous theoretical knowledge regarding this matter, the active work deepened the perception of bureaucratic-structural issues that made the implementation of social practices more challenging.

Because they are activities that aim to articulate the teaching-learning process with responses to the needs of the residents, our main analytical instruments were different forms of observation and discussion with those involved. We also mapped the conflicts that have occurred between the various actors involved. Besides it is important to emphasize that the activities embrace different moments of immersion of the different participating groups.

It is imperative to highlight that the work developed in partnership with the Federal University of Rio de Janeiro is not limited to the field of architecture and urban planning. Groups from several knowledge areas are involved and a variety of different actions and collaborative work has been developed among squatters, social movement, university and other actors.

MULTIPLE CULTURAL CONFLICTS: PREVIEW ACTIONS AND INTERNATIONAL COOPERATION WORKSHOP

By working with Solano Trindade, we achieved some important goals, but also accumulated some frustrations as well. At first, since we did not have the financial resources to develop a project, we counted on the participation of students engaged in the housing matter to develop of the architectural-urbanistic concept. Most of these students were developing their final undergraduate projects. It was the beginning of a strong articulation between extension and teaching practices.

The final undergraduate works were essential to the dialogue with the Federal Heritage Secretariat and other city councils. These projects also worked as guidelines for some actions, such as the partial recovery of the roofing, fencing of the land and studies for the requalification of buildings. There was also the implementation of Solano Trindade as a subject in some of the main existing curricular disciplines.

In the Interior Design discipline, for instance, students developed projects for the collective spaces in the main building of the squat, such as a library, a collective kitchen and a multi-purpose space. The experience was fruitful on one hand because it provided a possibility to explore design alternatives with affordable or reusable materials. On the other hand it was not possible to build what was initially planned, because there was not enough time or financial resources to do it.

It was at this moment that we truly realized the incompatibility between the curricular structure and the demands and needs of the squatters. This experience led us to develop another more intensive elective discipline which focused on the roof detailing and reconstruction. Along with the squatters we were able to rebuild part of the damaged main building roof. This was particularly important to the learning process of the students not only to achieve technical and empirical knowledge related to an important structure in Brazilian Architecture, but also to build their relationship with the local squatters.

Another important moment in the exchange between university and the squatters was the Summer School named "Interactive Knowledge Production in Self-organized Urban Areas", organized by a group of researchers and Professors from German and Brazilian universities. It was carried out in March 2018 and lasted 11 days. It was an opportunity to try to work in an even more intensive way at Solano Trindade, since we would be working there for several consecutive days.

The Brazilian and German undergraduate students designed proposals they had identified as the residents' needs and demands. In addition they were asked to think of ways to accomplish at least one

of their design proposals. Focusing mainly on this workshop, we discuss the limitations, challenges and potentialities that permeate the relationship between university and society.

We must address the difficulties of the process, which were a result of culture shock, the naturalization of the knowledge fragmentation, and a logic of evolution in the design and teaching-learning concepts. In this sense, it is worth highlighting:

- the difficulty of the German culture in dealing with the flexibility of planning in Brazil, which we can think of as a kind of improvisation culture, particularly in the adverse contexts of limited material resources;

- the mistakes made by both German and Brazilian staff during the preparation of the workshop proposal. At that time, we did not pay enough attention to the planning of the activities that were not open to the inevitable unpredictability of the reality of the Brazilian peripheries. In fact, we were not able to plan together an open program that was favorable to a dialogic process.

It is also important to notice that the research funding agencies usually impose a strict previous planning that limits the possibilities of a methodology that encourages the collective planning along with the participants of the activities.

Consequently, especially for Brazilian students, it seemed rather strange that the activities of project production have occurred outside the squat, in a place where the teachers, researchers and students were concentrated, without the participation of the main interested parties: the squatters. In the squat, the work was limited to consulting the residents about the project and its execution. No doubt there was interaction among all, but it was not enough since the population and leaders were not more effectively engaged in the project. This generated a great deal of dissatisfaction, which pushed us towards a more coherent alignment with our academic proposals.

Despite that, it was an activity that brought several positive outcomes for Solano Trindade and the actors involved. The Summer School was extremely important for integrating Brazilian and German students, as well as both of them and the residents, but also for having been an opportunity to intensify the organization of the squatters in Solano Trindade, especially the women in the collective kitchen. It was not exactly an expected result of the activity, but a consequence of the principle proposed by the MNLM itself, since the genesis of the occupation.

The collective kitchen already had a previous organization the resulted from changes in the method of organization implemented by the leaders and residents, as well as by the work of groups of UFRJ that introduced agro-ecological techniques for agricultural and culinary production. In order to be able to serve more than 40 people who would attend Summer School, however, it was necessary to intensify the organization of the kitchen. Then, other research group worked with the cooks in order to help them improve their self-organization skills. This effort also represented an important step towards professionalization of the workers-inhabitants, since it resulted in better remuneration for them.

There were also gains in terms of actions that represented improvements to the Solano space. The students contributed to the renovation of a vegetable garden planted in a mandala disposition; built an evapotranspiration basin, and designed and built a playground. This acquisition symbolizes an important realization of urban furniture not only for the children of the squat, but also for those of a neighboring school, who have also started using it.

The set of experiences carried out in the context of practical activities allows us to reach some conclusions.

ARTICULATION BETWEEN THE ISSUES OBSERVED DURING THE TEACHING AND EXTENSION

From our experience in Solano Trindade, we have identified potentialities and different levels of challenges. On one hand, the focus on practical issues allowed, for example, to break the boundaries of disciplines traditionally treated with an elitist approach, such as Interior Design. In this case it was interesting to notice that it was necessary to debate urban and legislation issues, building processes and building pathology, among others. On the other hand, we encountered a number of obstacles both to establish a more effective dialogue with residents, as well as for teaching-learning actions that are more engaged with the implementation of the projects. It is also worth mentioning the fluidity of the disciplinary limits that surrounds the fields that work with and in the city, such as law, engineering, sociology and geography, among others.

The specific case of the TU-Berlin and UFRJ workshop was an opportunity that allowed intensive reflection and action at Solano Trindade - something we could not have done with the disciplines alone. At the same time, it confronted us with a more rigid compartmentalization of the disciplinary field. From the discussions arising from the problems faced in this process, it was possible to hold another workshop in the current year that brought more effective advances to the Solano Trindade Squat.

After these disciplinary experiences developed over five years, we feel the need to advance beyond the work developed in the cracks of the disciplinary educational system. Although with an emphasis on architecture, urbanism and landscape architecture, the perspective was to stress both the necessary transdisciplinary dialogues in higher education, as well as to promote the encounter between different levels of education. Throughout these practices we have always had in mind the goal of blurring acute boundaries of social, gender and technical aspects in the work that was developed in the scope of the peripheral modernity that we are undergoing.

It is important to highlight that, in general terms the role of the university is not to enable or replace the work of public power. In the name of critical thinking, it is our responsibility to consider alternatives to social-spatial policies and actions that have been promoted by the State in its different instances. In this sense, it is entirely pertinent to reflect upon professional education, since it is at the root of the technical work that supports governmental actions.

In this context, it is essential to develop a consistent understanding of the role of architecture-urbanism-landscape professional training in the contemporary world, understanding that the technical-scientific values that guide the practice are inserted in a socio-spatial and historical context.[7] In the sense of the transformation of cities and metropolises of the peripheral world, it is vital to remember that the population is not the object of these disciplines, but also producers and reproductive agents, urging the use of teaching-learning methods that increasingly bring them closer to the construction of knowledge and design decisions[8]. Restructuring teaching in such a way as to allow this approach, as well as the understanding of historical and geographical particularities in a globalized world, involves the experimentation of architecture-urbanism-landscape at the body scale[9]. The socio-environmental issues that are worsened in contemporary times, urge for the renewal of an education that results in an architectural praxis that is sensitive to the site and its context and also to the increasingly interconnected world[10].

NOTE

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BEING INSTAGRAMMABLE: HOW TO TRAIN ARCHITECTURE STUDENTS TO THE POWER OF NEW SOCIAL MEDIA

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INTRODUCTION

Instagram is a successful social media platform, launched in October 2010. It has reached fast popularity making it the most interesting phenomenon of the web. In order to understand the importance of such a phenomenon some data are useful.

The platform counts 1 billion of monthly active users, 600 million daily active users and 500 million users watching stories on a daily basis. Since its launch Instagram is becoming more and more popular, the increasing is indicated by the number of downloads of the mobile app.[1]

In March 2012 downloads of Instagram were seven times more than in May 2011.[2]

After the release of the Android app and the Facebook acquisition in April 2012, the number of downloads increased even more.[3]

Architecture is already affected by the huge impact of such a phenomenon and Academia cannot ignore the power of this new social media. Times are mature to incorporate it not only as communication tools but also as a design thinking tool all along the teaching/learning process.

INTUITION & INTERACTION

Instagram is a very intuitive and interactive mobile application. For those not familiar with it a short description can be useful. Users can activate their account (open to public or accessible to friends only), under their name or a nickname and post images, with or without filters, directly from their mobile phone. Users can also open different accounts, maintaining the possibility to switch from one of their accounts to another directly from the mobile app. The contents of the platform are mainly visual (ninety-five million photos are uploaded daily), all photos are in the format of squares that are visualized as single at the moment of the posting and then collected in the account in a scrolling format of a row of three images.[4] The app allowed the users to follow other accounts and to be followed, so to prioritize the visualization of the posts. Followers can give their likes to images, posting comments, and send messages to other accounts. The short text under the image can be completed by a # followed by a keyword, in this way all images with the same content/hashtag, coming from different accounts, are grouped in a dedicated # page open to all.

The audience interaction can be enhanced by tags (to add on the photo directly or in the short text below), in order to invite specific accounts to the vision of the post. Recently more options have been

added; stories are instant short movies published on the account for twenty-four hours only; selected stories can be saved as highlights in the account so to make them visible permanently.

INSTAGRAM & ARCHITECTURE

The most successful businesses on Instagram seem to be restaurants, bars, and tourism, but there is no doubt that architecture is taking a key role among the users and the posts.

The role of social media in this field is documenting the making of architecture and showing its final product. Recently, offices of architecture started to use more effectively Instagram than other social media and archi-stars manage their own accounts, arriving sometimes, as in the case of Bjarke Ingels, to pure self-promotion more than the communication of the actual buildings.[5]

Specialized web-magazines like Dezeen and ArchDaily published several articles about the phenomenon and they review constantly the top ten Instagram accounts.

Farshid Moussavi, in an interview on Dezeen, admitted that clients are demanding instagrammability and that creating instagrammable moments, is becoming an important part in architectural briefs. [6]

Architecture is acting in a similar way that the hotel sector, where rooms and locations are advertised together with the possibility of posting key hashtags.

There is no doubt that Instagram is changing the way of designing, one key aspect is the light of the interior space, where a bright effect is necessary to take a photo or a selfie with the best exposure possible.

The Australian office VALE Architects, in 2018, published a digital Instagram Design Guide (release 1.2) containing key advice to make the business instagrammable, affecting in this way, for sure, the design of spaces and buildings. After presenting a screening of different typology of users, the guide lists key features to be instagrammable: natural settings, signage, swimming pools, lighting, murals, tiles and textures, food and drink presentation, operating supplies and equipment.[7]

Also, the magazine Wired published an interesting article with the title: "Selfie Factories: The rise of Made-for-Instagram Museum".[8]

This social media is demonstrating to be also an efficient instrument in the study of urban phenomena, showing the potential of taking the role of a key research tool in both urbanism and architecture.[9]

Instagram is for sure a pop phenomenon, but it is bringing to a revolution in the same way the photography did.

The debate is open on the future evolution of the Work of Art depicted by Benjamin, but the move from the mechanical reproduction to the digital reproduction it's impressive.[10] In the case of architecture, the revolution is deep: the camera is not in the hands of expert photographers anymore and the images are not published in specialized magazines as in the past. We are in what we could define a new era of visual democracy where anyone has the possibility of taking and sharing photos.

Far from the desert spaces published in traditional paper magazines such as Domus, Casabella or Architectural Review, a new style of communication is growing. Architecture is nowadays brought to life by the instantaneous shooting and sharing of selfies and stories published on new social media.

The still life spaces, that only a few photographers, like Julius Shulman, tried to animate and depict in the daily life of their users, is now recorded by the users themselves, bringing to a hyper-fragmentation of the representation of architecture and to a hyper-realism never seen before.

Following this new wave of representation, architecture offices like OMA do not post professional photos of their buildings anymore but share on Instagram instantaneous photos showing how the users perceive the building.

Instagram doesn't offer only to architects the possibility to be seen, but also to see, explore and take inspiration. The new social media is an infinite and open-source of visual information that, thanks to specific accounts and the possibility to follow #s can be personalized based on needs and preferences.

A very interesting aspect is the use of Instagram by architecture schools. In 2016 sixty schools of Architecture across North American run active Instagram accounts.[11] The advantages are several: exposure for schools and students, connection with other schools, architectural firms, and university alumni.

Schools mainly use their accounts to showcase students' work, sharing university life moments, promote and advertise events. In all these cases Instagram is considered the media not the source nor the tool. Architecture schools still produce a standard format of contents, where the innovative aspect is only the platform used to publish them, just in very few cases they investigate the way to involve students in their production and even more rarely they use Instagram as a learning tool in architecture courses.

INSTAGRAM & TEACHING

In May 2017 Adrian Phiffer published on the web-magazine ArchDaily an article with the title: "Why Instagram should be a part of every Architect's design process".[12] Phiffer highlights the value of Instagram by being thinking in images. A new digital version, quoting the author of the article, of the physical Mnemosyne Atlas, created by Aby Warburg, in an appealing digital square format.

If in the last century new media became integral parts of the arts, affecting also architecture, in this century digital social media can have the same power.

Following these thoughts, the author of this paper decided to integrate Instagram into the teaching process of some courses. The willing is not only to show the design process or the actual final result but to ask students to think about both as something that should live in the digital realm of social media only. Instagram is not only a media to show the process, but a tool to be incorporated in the process. As it happens for traditional representation (orthographic projection, sections, axons or perspectives) they can be the final way of representing architecture, but also a way for understanding and analyzing architecture itself. The first, simple move, is from the UNI format of the paper, still presents in BIM and CAD softwares, to the abstract size of the square format. Starting from 2018 Instagram has been integrated, by the author, into courses of Theory of Architecture, at the American University in Dubai, placing as the final task of the course, not the usual production of a final A4 portfolio, as done before, but the publication of a final digital collection of posts on Instagram. In this first experiment, the instantaneity of the communication system was forced to a more static representation by asking to upload all the contents to the accounts at the end of the term. The strong contradiction is that the concept of the final doesn't exist on Instagram, only the series. Even if recently a new # is taking more and more importance, #throwback, the instantaneity of the post remains the main aspect of this social media, and the infinite series of posts with no end only makes sense. This first experiment was anyway successful, making students focus on the potential of the representation, working on single posts and the sequence of images at the same time. The issue, of course, was not only graphic but conceptual.

Students were required to read critical texts, on different topics, throughout the term, produce collage and models in consequence of their reading, and post the final combination of models-collages and quotes from the texts, organized by images grouped under single topics. The collages were in a square format and all models started from the ideal shape of a cube as illustrated in figure 1.
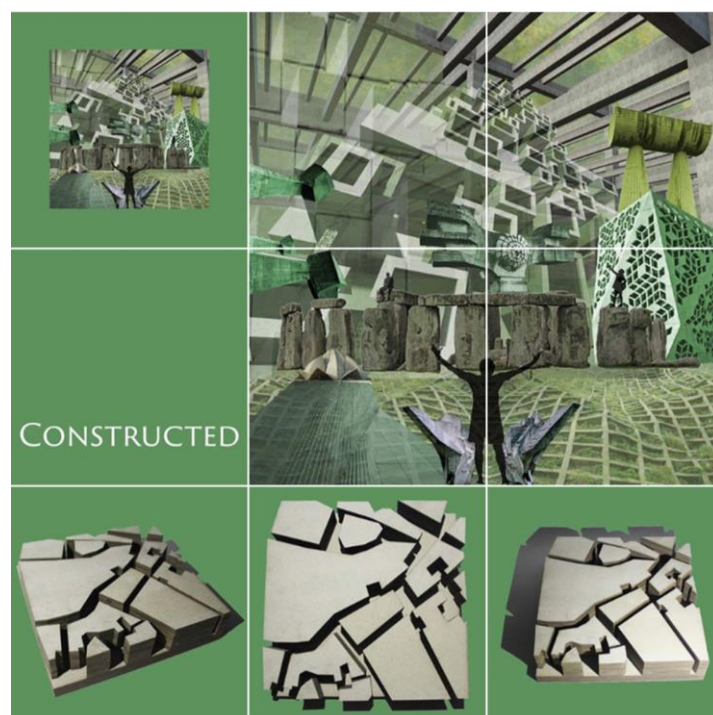
Figure 1. Theory of Architecture. Example of a group of posts under one concept (Alyna Ahmed).

Topics deeply rooted in the realm of architectural theoretical debate, like the matter of scale, the material and the immaterial, the honesty and the deception, the simple and the complex, took a different meaning or opened different points of view and a wider debate in relationship with the media used to communicate them. Most recently the method has been inverted, asking students to publish contents, not at the end of the semester, but throughout the term, creating in this way a learning environment deeply affected by the use of Instagram and its instantaneous posts.

The task has different faces: on one side it forces students to think 2D and 3D objects to be finalized on Instagram, in order for them to understand what is really instagrammable; on the other side, it trains students in reading the deception that this kind of social media necessary incorporate. Deception, discussed in the course for its negative and positive aspect, is also something that students learn to apply in their posts, retouching their photos in a similar way that they do in the case of their selfies. The aim is not bringing students to apply a deception that makes the Instagram object, completely independent by the architecture object, a fake better version of a bad actual result, but educating them to understand it, and recognize it, in order to be able to act, react, think and design in a world of deception.

A third task is forcing students to think about Instagram, not only as a personal account where to post selfies or to follow celebrities but also as a professional learning tool to follow schools, architects, architecture offices, #s that can enrich their background. In order to bring students to this task, they were asked to integrate the study of the main architectural modern movements with some #s, able to represent the movements at their best. The use of Instagram as observers can enhance the critical thinking of the students, but only if they first acquire the right sensitivity and they have the right knowledge of the media. The courses of Theory of Architecture delivered, making the use of Instagram, are exactly trying to create this kind of observers: critical digital thinkers.

The use of Instagram not only engage more the students but also bring them to see all their production published in the same # page, forcing them to an instantaneous self-assessment and to the

comparison/competition with others on the web. This aspect is nowadays deeply stressed by the presence of social media and can be considered an integral part of the contemporary architecture realm; therefore, students have to learn how to deal with it with positive, instantaneous responses.

For this purpose, Instagram has been recently used for some in-class assignments in History of Architecture courses. In a forty-minute exercise, students were asked to produce contents to post on Instagram making use of their mobile phone and basic graphic mobile apps only.

The idea was to give students the task to respond to a requirement in a very short time and publish it immediately, forcing them to deal with basic tools only.

Architecture has to train students to be critical thinkers and problems solver, in the forty minutes in-class assignment both outcomes were covered. What we have to educate students to, is not only to master digital social media but also to see a potential that is still unseen and to be able to figure out other types of uses than the standard.

In a study tour to Rome, organized in November 2018, Instagram has been used for the first time on-field. The course, entitled Capriccio Romano, was a combination of daily tours, based on the map of Gianbattista Nolli, organized and guided by teams of students; on-site assignments, designed by the same teams, and a series of lectures, in collaboration with Sapienza University and some offices of architecture. Students have been invited to open group accounts at the arrival in Rome.
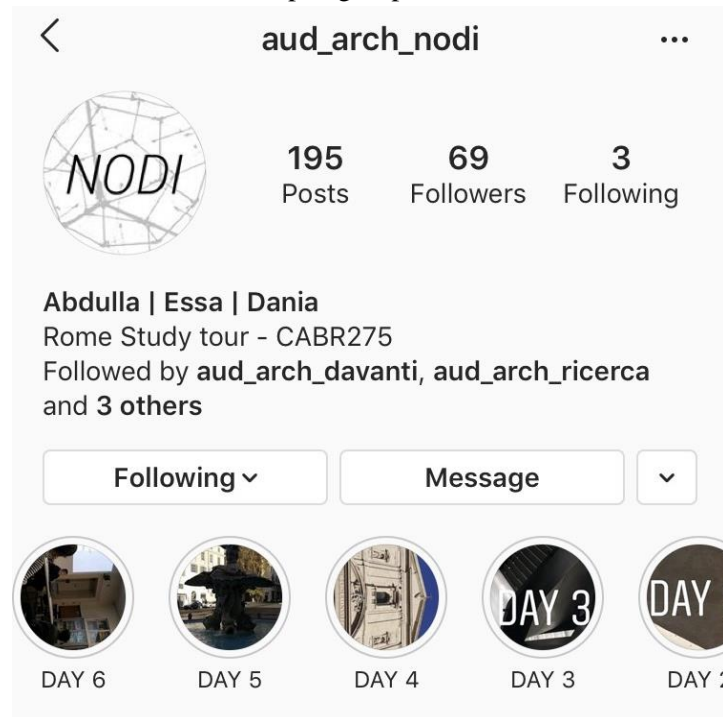
Figure 2. Rome Study Tour. One of the account with daily stories in the highlights
(Abdulla Alzarouni, Essa Alzarouni, Dania Aqel)

Instagram, in this case, was useful to share and communicate information on-site and to create a learning-traveling community that could interact and coordinate on the web. The social media was able to be used in a more unconventional way, and for a multitude of purposes. Teams preloaded basic information, necessary to make the guidance of their tours more understandable, engaging and effective.

They decided to use the squared photo format to upload, maps, plans, sections, old blueprints, related to their tours in order to make the exploration of the urban environment more interactive.

In some cases, students themselves made proposals on how to use Instagram to respond to certain tasks. They decided to upload the daily experience of the tours as short movies in the highlights and add in these stories also the multimedia submission of the on-site assignments as illustrated in figure 2.

As final requirements, once back to Dubai, students defined keywords able to express at the best their urban experience of Rome and uploaded collages under key #s such as topography, enclosure, contradiction, layers, continuity, resilience, network, scale, points, light, water, alien as illustrated in figure 3.

The final collages have been obtained by the combination of pictures taken by the students during the city tours. This method allowed them to sediment their experience of the city, consolidate their memories and re-think and re-elaborate the urban environment in a more critical way.

Figure 3. Rome Study Tour. Group of posts related to a key hashtag
(Abdulla Alzarouni, Essa Alzarouni, Dania Aqel)

The challenge in both cases, theory of architecture and study tour, was to communicate concepts, more than empty images or moods, a potential that can represent one of the future possible development of the platform, shifting the visual communication to more abstract contents.

CONCLUSION

In conclusion, the choice of the collages for the Instagram assignments deserves a brief explanation. The collages or Capricci[13] are fragmented visions that leave space for metaphors and interpretation, they are the visual materialization of communicative spaces that differently than the perspectival spaces of the past, are able to translate the modern complexity.[14] This fragmented vision is in perfect empathy with the fragmented visual realm given by Instagram, therefore, a learning experience, nurtured in the simultaneous mutual visual exchange of collages and posts seems to be the most appropriate way to bring students to the comprehension of Architecture.

The initial experimentation of the use of Instagram in courses of Theory of Architecture and Study Tour brought to two parallel results: on one side increased the level of engagement of the students as demonstrated by the result recorded in the students' evaluations of the courses, on the other side stimulated them to conceptualize aspects related to architecture and urban environment, with the additional challenge of condense and express them in one post only to be shared and exposed to a wider public that can give comments and express judgments.

The use of Instagram in learning/teaching/researching processes is still a field to explore in-depth with huge potential. The new additional tools integrated into the app on a regular basis offer new stimuli and occasion for discussion.[15] The question about if and how to engage good quality followers in the process and how to make and maintain the "academic" digital accounts still active after the conclusion of the course remains a key aspect to improve, debate and clarify in the future.

The methodology has still to be explored; application in different architecture courses, through a multiplicity of assignments, has to be tested and understood.

The author will bring the research forward by the following main actions; continuous experimentation in Courses of Theory of Architecture and Study Tour; farther experimentation in other courses such as History and Theory of Architecture III and Sustainable Urbanism through the collaboration with other faculty; elaboration of specific assignments in each of the courses able to implement the learning process of the students; creation of specific rubrics for the evaluation of the Instagrammable creative work of the students, elaborating a scale of value specific to this type of assignments; systematic collection of data through the comparison of existing course-assessment methods and the compilation of more specific surveys by the students to understand better and verify the consistency of the learning outcomes.

NOTES

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TRAINING FOR KNOWLEDGE TO ACTION: TOOLS FOR THE METROPOLITAN ARCHITECTURE DISCIPLINE

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THE FOUNDATION OF THE METROPOLITAN DISCIPLINE

We call on leaders of public opinion, on educators, on all interested bodies to contribute to an increased public awareness of both the origins and the severity of the critical situation facing mankind today. Each person has the right to understand fully the nature of the system of which [s]he is a part, as a producer, as a consumer, as one among the billions populating the earth[1] .

We consider the goal set by the Cocoyoc Declaration of 1974 as the goal of every action. It inspires the outline of the training programme we are building and testing within the TELLme – Training for Education, Learning and Leadership towards a new Metropolitan discipline, which is a Strategic Partnership for Higher Education ongoing project, co-financed by the EU Commission within the Erasmus+ programme.

The Metropolitan Discipline – whose foundation is the main objective of TELLme – aims to provide answers to the extreme urbanization and its phenomena. Given the complexity of its subject, the fragmentation, diversification of territories and environments, and the multiplicity of stakeholders, the Discipline is conceived as a "discipline of practise", in which the theory is fed by the practise and its practise-led research is connected to a continuous experimentation on concrete case studies.

This position of the Metropolitan Discipline requests a wider reflection on knowledge and its connection with action. While this connection is always crucial – and it has been stated when the EU was called a "knowledge based" society – it is particularly the case for the Metropolitan Discipline, both because it explicitly addresses policy makers and all the stakeholders that "build" the city, and because the communities can find tools – particularly the maps – empowering their capacity to take part in the decision making processes.

In fact, the question of "action" – which refers to a deeper question on what is left to action in the age of technology – is elicited throughout the project, as well as politics, being the "political" dimension, which is linked to action.

This is the first and main challenge for a training programme: to train to a discipline whose theory is built on the practise, and the practise is shaped by the theory.

SKILLS, ATTITUDES AND VALUES AT THE CORE OF THE LEARNING PROCESS

The crucial importance of "practice" implies the need for training in competences, in knowing how as well as in knowing that. For producing a metropolitan project, participation and consensus are as important as the project itself, due to the many different groups of stakeholders involved. Flexibility, cooperation, interdisciplinary and systemic thinking are mandatory, advancing from the dominant situation of disciplinary separation, leading to work in silos. A metropolitan project is linked to the analysis of vocations and expectations of the region of which a metropolis is the expression. A metropolitan project is a matter of localizing investments with a social impact in order to define an integrated and sustainable development, a new pact between local citizens and migrants and between this new community and the territory. It also calls for the need of highlighting the many values that can be read in the history of the territory and that can be put into motion, in order to qualify new centralities.

The training process aims to allow the participants to achieve awareness of the need for a metropolitan vision and to develop skills and ability to operate in the complexity linked to the size of the contemporary metropolis. This "metropolitan" competence is obtained with the integration of managerial skills with architectural and urban skills, capable of extracting the metropolitan gaps and needs of each metropolis, of defining the metropolitan operations that each metropolis needs to overcome the gaps and respond to its needs.

TRAINING FOR EVALUATING AND CREATING

Knowledge Dimension	Cognitive Process Dimension					
	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge						
Conceptual Knowledge						
Procedural Knowledge						
Metacognitive Knowledge						

Figure 1. The table is taken from Anderson and Krathwohl (2001).

The TELLme Training works on the higher levels of the cognitive processes implied in the different knowledge dimensions framed in the Anderson and Krathwohl (2001) revision of the Bloom's taxonomy[2]. In fact, the main and most significant revision is about the knowledge dimension: "knowledge" is taken out of the cognitive domain and added as a separate dimension, recognizing four distinct knowledge dimensions (factual, conceptual, procedural and metacognitive). The table below shows that – instead of six ways to think about one type of knowledge, as in the Bloom's Taxonomy – there are now six ways to think (Cognitive Process Dimension) about four distinct types of knowledge (Knowledge Dimension).
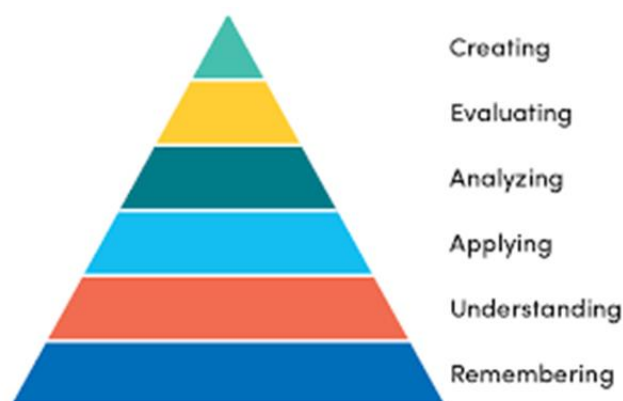
*Figure 2. A representation of the six cognitive process dimensions in the form of pyramid,
implying that the higher levels are built on the lower ones.*

Among the recurring thinking activities at stake in the TELLme trainings we can list: planning, negotiating, deciding, judging, choosing, assessing, mapping, interpreting, testing… they all refer to the higher levels of the cognitive processes of the revised bloom's taxonomy, which are "creating" and "evaluating".

The training addresses this need both in the consideration of the admission requirements of the participants and in the adoption of the flipped classroom pedagogy[3] among the pivotal references of its learning methodology. Against this pedagogy a set of video-courses on the Cartography were produced[4].

TRAINING THROUGH IMPLEMENTATION TOOLS

The conception of the metropolitan discipline originates from the investigation of the existing situation analysis of the metropolises in the five countries involved in the project (Italy, Spain, Slovenia, Mexico, Argentina). The research produced the development of a conceptual theoretical framework and a methodology, together with a vast array of implementation tools[5], consistently with a research which is in itself already practice led.

Drawing from the implementation studies (mainly focusing on health care, where the issue of immediate translating of research into practice is literally a vital concern) and adapting the wording to our context, implementation might be defined as the process of putting to use or integrating research and new practices within a setting[6].

TELLme tools are meant to accompany the process of translating research into practice and therefore they can be considered as "process models"[7] since they explicitly take a process perspective of implementation, recognising "a temporal sequence of implementation endeavours"[8].

The cartography is the groundwork tool – together with the hub, which is a "hard tool" – developed by the project on which all its practical tools are built. In fact, every map is conceived as a semantic package connected both to the theoretical framework and to data. In this sense, the maps are the tool and the medium for connecting the theory to the practice, and for understanding and reading the territory according to the theoretical principles and concepts[9].

TELLME GLOSSARY AND GLOSSARY SOFTWARE AS THE MAIN TOOLS

Since its inception, the TELLme project deemed necessary to produce a Glossary, as an attempt to allay confusion and misunderstanding. In fact, the need for a Glossary[10] as a fundamental tool of mutual understanding and clarification was strengthened by the TELLme Training Lab held in

Guadalajara in February 2019 and in the many occasions in which the TELLme approach and results were presented to the stakeholders. The Metropolitan Discipline refers to a field in which targets and stakeholders involved belong to different environments (Higher Education Institutions, policy makers, NGOs, multilaterals, etc.). Moreover, TELLme – beside its international partnership – directly addresses the transnational dimension and relies therefore on the use of a common language, which is English, through which the different national terminologies are translated. The way to unravel the tangle the Glossary took was to try to explain the meanings of the terms in the context of the Metropolitan Discipline.

The Glossary Software enables the visualisation of the relations between the Glossary keywords, fully exploiting the richness of meanings, comments, references and images and producing Semantic Maps of the Metropolitan concepts.

The TELLme Glossary Software[11] is conceived as a bridge connecting the theoretical framework of the Discipline and the Cartography Hub, which is a digital platform the project built for producing and storing maps. The Glossary Software was therefore developed adding to the Discipline a transversal tool that substantiates the link between all TELLme outputs, thus becoming crucial for the training activities.

STAKEHOLDERS MAP: ARCHITECTURE OF THE JOINT

The issue of governance is addressed through the creation of a stakeholder's map that reflects the core values and the issue of the subject matter and balances the participation amongst the local and global metropolitan actors, and the metropolitan experts. The stakeholders bring the relevant topics on the table of the TELLme training, to be discussed following the Metro-dology.

The Metro-dology begins with three phases: the problem finding, the problem setting and the problem solving. In fact, the production of a metropolitan project requires an agreement between different metropolitan actors. This agreement can be reached in different ways, corresponding to different theories and forms of stakeholder aggregation[12]. Almost all complex agreements are made up of many parts that require connexions. The objective of "modular tables" is not necessarily to limit the total number of stakeholders and the rules of their interface on a given table. Instead, the focus is on geography and, therefore, on the position of the individual actors and the reasons that can unify them. The least desirable place to unite stakeholders is the final meeting point at the end of the decision-making process. The theory of dialogue was once hierarchical, with most of the actors united in the place of the final decision. The theory was that a control structure would ensure the social quality and manage the costs of the metropolitan work, keeping as many agreements as possible under the direct control of the final decision-maker: the politician.

In the contemporary theory and practice that recognize the essentially chaotic nature of the agreement in complex projects, the focus is instead on disassembling the process into small groups of integrated tables (a module). These smaller tables can then be designed and managed independently, as tables composed of separate teams focused exclusively on a part of the overall project. Quality control can be managed incrementally, one module at a time, with corrections made before the final decision. That is the art of listening and joining.

The matrix mathematics behind this agreement theory is powerful. Simply stated, the relationship between the number of stakeholders and the potential interfaces between them is exponential: two stakeholders have a single interface (2:1), 4 stakeholders have 4 possible interfaces (1:1) and 16 generate 24 potential interfaces between these parties (2:3). Each of these interfaces between two of its stakeholders is an agreement, in equal measure, an opportunity for both the positive and negative result.

When we carry out any project, we tend to focus on the actors and their characteristics, producing a catalogue of necessities. However, there is no comparable catalogue of interfaces, but their potential number exceeds that of the disciplinary themes of an ever-increasing exponential relationship. The amount of energy and time needed to solve all the problems of relationship in the design and agreement construction of any metropolitan artefact is staggering.

First, each agreement determined is in itself a problem: the civil servant within the metropolitan expert define the problem and ask the questions. The objectives for the solution and the constraints that the "agreement interface" must satisfy are identified. Each interface therefore requires an act of design both for selection and for custom design of the agreement. Each of these potential interfaces between the parties must be developed. However, the number of type changes required is considerable.

Usually the solution was found in the mathematics of the agreement. Now every connection between stakeholders is a matter of listening, a matter very similar to a very accurate craftsmanship. Each of the possible permutations must be carefully thought out and implemented within a certain time limit. The mere willingness of the parties to reach the final agreement is not only a logistical fact, but a profound understanding of the values behind the different interests and investments. Deficiencies in quality in bureaucratic agreement method are inevitable, if they are only issues of productivity and cost.

If more actors generate more agreements exponentially, then the opposite is also true: fewer actors generate fewer agreements exponentially. There are two possible solutions: to fragment the process of agreement or to reduce the number of actors. A reduction of actors requires a complete redesign of the project's parts themselves. It is more difficult and takes more time to test actors than to redesign the process. Since time is an expensive commodity, most facilitators have focused first of all on the fragmentation of the process of designing agreements for discrete tables: sectors, small inter-sectors tables, large decision tables. These are composed of a series of stakeholders similar to the ones before, simply moving back the process. The problem of the agreement is not solved, but it moves to another place and time, it moves to another location.

The changed place in term of table/decision making level, however, is a significant part of the solution. A very complex problem turns into a series of smaller and less complex problems. The resolution of the project can be more targeted. And there is less complexity to deal with in the final agreement process. However, there is a new central design issue that concerns how to combine small inter-sector tables, large decision tables and the scale of sectors. In this world of modular design, agreements between metropolitan actors are no longer simply a solution to that single problem. They are now so much, or more, a matter of shared values in the decision-making chain where decisions must now be parallel. We are talking about a decision-making chain, but it is no longer a mechanical process, as we have already seen, but a process of sharing and listening.

CONCLUSION

According to TELLme, the metropolitan discipline is based on a knowledge to action learning process, requiring tools, both for training purposes and for its application in the life of metropolis planning and management. A variety of tools – from maps, glossary, digital platform, stakeholders map – were produced and tested. We believe that for enabling decision making on the metropolitan scale, every city needs instruments that helps policymaker to define objectives based on SDGs and their impact indicators.

NOTES

[1] The Cocoyoc Declaration, 1974. On the 8-12 October 1974 a symposium on "Patterns of Resource Use, Environment and Development Strategies" was convened in Cocoyoc, Mexico by Maurice Strong and Gamani Corea, the directors of United Nations Environment Programme and the United Nations Conference on Trade and Development. The participants adopted The Cocoyoc Declaration.

[2] Benjamin S Bloom; Engelhart Max D.; Furst Edward J; Walker H. Hill;. Krathwohl David R, Taxonomy of educational objectives: The classification of educational goals. In *Handbook I: Cognitive domain*, 1956, New York, David McKay Company. Bloom's Taxonomy is one of the most recognized and used educational tools, proposing a hierarchy of types of thinking—from recall to analysis and synthesis. In 2001 a revision of the Bloom's Taxonomy was published by a research team led by Lorin Anderson, who worked closely with Bloom on the original version: Anderson Lorin W., Krathwohl David R., Airasian Peter W., Cruikshank Kathleen A., Mayer Richard E., Pintrich Paul R., Raths James, Wittrock Merlin C., A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives, 2001, New York Longman.

[3] The expression "flipped classroom" refers basically to a learning process in which tasks are assigned to students in order to cover material prior to the class meeting. During class meeting, teaching can be highly interactive through questions and answers, exercises, applications and case studies. As references we can mention Eric Mazur, Peer Instruction: A User's Manual, 1997, Prentice Hall ; Lage Maureen J., Platt Glenn J. and Treglia Michael, "Inverting the Classroom: A Gateway to Creating an Inclusive Learning Environment", in *The Journal of Economic Education, Vol. 31, No. 1,* pp. 30-43, Winter, 2000.

[4] See https://www.youtube.com/watch?v=ikNegzgbFM&list=PL5mxbfx_mti_RHZg5oRvHdR4cPsVZASJZ and www.metropolitancartography.org _ passphrase: the arts are learnt by reason and method; they are mastered by practice.

[5] On the importance of tools and toolkits in implementation, see Brownson Ross C., Proctor Enola K., Luke Duglas A., Baumann Ana A., Mackenzie Staub, Brown Matthew T.& Johnson Mallory, Building capacity for dissemination and implementation research: one university's experience, in *Implementation Science* volume 12, Article number: 104, 2017.

[6] See Borsika A. Rabin, Brownson Ross C., Haire Joshu Debra, Kreuter Matthew W., and Weaver Nancy L., A Glossary for Dissemination and Implementation Research in *Health, Journal of Public Health Management and Practice,* 14 (2), 117–123, 2008.

[7] Process models (or frameworks) "specify steps (stages, phases) in the process of translating research into practice, including the implementation and use of research. The aim of process models is to describe and/or guide the process of translating research into practice. An action model is a type of process model that provides practical guidance in the planning and execution of implementation endeavours and/or implementation strategies to facilitate implementation", Nilsen Per, Making sense of implementation theories, models and frameworks, in *Implementation Science* volume 10, Article number: 53, 2015.

[8] Ibid.

[9] Maps plays also the relevant function of communicating, translating and sharing knowledge and thought.

[10] Relevant reflections on the confusion dispelling power of glossaries are in Graham Ian D.; Logan Jo; Harrison, Margaret B.; Straus Sharon E.; Tetroe Jacqueline; Caswell Wenda; and Robinson Nicole, Lost in knowledge translation: time for a map?, in *The Journal of Continuing Education in the Health Professions, Volume 26, pp. 13–24,* 2006.

[11] www.tellme.polimi.it/tellme_apps/tellme

[12] In the past, agreements were mainly born from the relationships and the dimensional and economic limits of projects. A central aim of the concertation tables was the management of these interests. The relationships that separated even dissimilar interests and allowed the junction of similar interests that individually could not be produced if defined only at the urban scale.

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TEACHING INTEGRATED ARCHITECTURE AND URBAN DESIGN USING A TECTONIC ATTITUDE AS PEDAGOGICAL METHOD

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INTRODUCTION:

This paper discusses a pedagogical method based on what in this paper is introduced as a tectonic attitude. The methodology is applied to an undergraduate studio called *"The relationships between architectural and urban space",* taught at Aalborg University, Denmark, to 5th semester bachelor students of Architecture and Urban Design. The studio is designed to stimulate the students' understanding of context, and to enable their reflection on potentials and challenges in the relationships between buildings and urban spaces.

The studio arises from a reading of the challenges in contemporary building culture, as applied to the construction of new cities. Examples can be found across the world of such cities and urban redevelopments, full of good intentions and sufficient resources but that are experienced as mediocre, disjointed and made up of autonomous buildings of standardized solutions.

Theoretically the shape of the contemporary city can be understood as a set of intertwined, global, mega trends. These trends come from a growing awareness of the city's role in ecosystems and the sustainability movement[1] [2], an understanding of the city as the spatial facilitator of the good life associated with the notion *'livability'*[3] [4], and an increase in the implementation of urban technologies and smart city solutions[5] [6]. But these mega trends cannot provide an adequate understanding alone. As with everything else, the contemporary city is entangled with economy, which among other things includes crude speculation in the development of the city, a race for increased profit through standardized architecture, and a maximizing of returns from space available for rent or sale. If the spatial result of this is autonomous architecture, an excess of standardized architectural solutions and pre-fabricated apartment blocks not defined by their context, how are we as architects and urban designers supposed to challenge this tendency? As teachers of architecture and urban design, our proposed solution is to approach the challenge through the education of students. The current studio is an attempt in this direction.

From the perspective of an architect, one of the challenges of contemporary building culture is a lack of sensitivity towards how the city is experienced, resulting from how the city is put together and assembled. How do we consciously shape the spatial experience in the joining of the new and the old city, in the joining of buildings and urban spaces, and in the joining between public and private?

Historically in architectural theory, the notion of tectonics has provided an understanding of how spatial experience is affected by the joining of architectural elements. Can this theory be re-developed to provide a new foundation for an understanding of the relationship between the experience of the city and how the city is assembled?

Developing a tectonic attitude

The current understanding of the notion of tectonics is usually accredited to the interpretation by Kenneth Frampton of the *"poetics of construction"*[7]. Others base their understanding on Eduard Sekler's distinction between the concepts of a.) structure: referring to the conceptual system of arranging load-bearing members; b.) construction: referring to the acts of realising a building in materials and structures, and c.) tectonics: referring to buildings' expressive qualities[8]. Some sources build their interpretation of the notion of Gottfried Semper, who claimed that architecture *"... like its great teacher, nature, should choose and apply material according to the laws conditioned by nature, yet should it not also make the form and character of its creations dependent on the ideas embodied in them, and not on the material?"*[9]. An understanding of architecture derived from this quote elevates ideas of *'material'* embodied in architecture, and thus proposes the meaning of architecture as how ideas are manifested in materials and structures.

On a conceptual level, this interpretation is echoed and refined in the reflections on architectural detail in the writings of Marco Frascari[10], who has been associated with the theories of tectonics. Frascari studied the architectural detail and its role in the creation of significance in architecture. He proposed that *"the construction and the construing of architecture are both in the detail"*[11], and claimed that what is perceived as an architectural detail is always a joint. According to Frascari, the meaning of a building is found in the relationship between how a joint is constructed, and how it is interpreted. In this interpretation, it can be understood that tectonics is concerned with how ideas are realized, and how architectural elements are detailed: *"The art of detailing is really the joining of materials, elements, components, and building parts in a functional and aesthetic manner"*[12]. The theoretical proposal in this paper is that this position on tectonics could be extended beyond buildings, and thus engage with how the city is assembled.

Applying tectonics to how we understand and shape the city goes beyond the scope of traditional tectonic theory. It relates to critical thinking about architecture and the city, and in that interpretation, it embodies something we term *'an attitude'* for understanding and shaping the city. An attitude that pursues the meaning, or the experience of the city, from how ideas are manifested in detailing physical materials and structures.

So far, we have called this approach to the city Urban Tectonics, and it has been an attempt to bridge concerns of architecture and urban design, which we have been working on for some years within teaching[13], and more recently within research[14]. The studio presented in this paper builds upon these precedents. The teaching experiences started as a study of the relationship between buildings and urban space through section model studies of selected famous built projects. The current studio continues this work by requesting students to not only understand the current urban situation, but additionally requires them to propose a conceptual redevelopment based on their initial study.

THE PEDAGOGICAL METHOD

Overall, the studio comprises a 3½ week crash-course in urban analysis and conceptual architectural design. In the first part, the students are asked to do an analysis of a given site in order to develop an understanding of the potentials, challenges and characters of the site. To facilitate the analysis, the students are introduced to various classic and experimental approaches to site analysis including

mappings[15], serial visions[16], image of the city[17], urban tomographies[18], etc. The students individually choose the methodologies they prefer to apply and experiment with, and spend a week studying the site individually. Some of the methods are introduced with exercises, where results are presented in plenary by the students, and in general the analysis is done collectively, thereby promoting peer-learning among the students. This aspect is important in making sure that even weaker students come through the analysis phase with useful results. The analysis concludes with students identifying the essence of their understanding of the site based on their analysis, and they are asked to visualize this interpretation in a descriptive diagram or an illustration.

The subsequent design phase builds upon the knowledge obtained in the analysis, especially the concluding illustration, representing the essence of the students' interpretation of the site. The design phase is facilitated by workshop activities where students experiment with models and materials. They conclude the design phase by developing an architectural model that communicates their proposal, or a part of their proposal, for a re-development of the site with clear references to their initial site analysis and interpretations.

Throughout the studio, supervision, pin-ups and interactions with students and teachers support the individual process. The studio concludes with the students submitting a poster with their analysis, interpretative illustration, pictures of their model-development, a presentation model and a short reflection based on their experience of the studio; in addition, they submit their views on the potential of working with the shaping of the relationship between architectural and urban space. This submission shows the students' entire learning from the studio, and thus represents to what extent they have developed the tectonic attitude.

The presented pedagogical method attempts to encourage the students towards developing a tectonic attitude, through the clear objective of building their proposed architectural redevelopment on the potentials and challenges, and their interpretations of the site. In this way, the students are forced to consider how, on a conceptual level, their design proposal reframes the interpretation of the site and their design proposal. The students are thus engaging in a design process that asks them to consider how their design is assembled with the existing city. In this aspect, the site is a very important aspect for the pedagogical method, as it sets the framework for initiating the student's development of a tectonic attitude.

THE SITE

Located centrally in Aalborg is an urban block known as Kjellerup Torv (figure 1). The block is placed between the historic inner city to the south and the contemporary large, box-like buildings next to the harbour-front to the north. The urban block consists of adjoining, individual buildings, where some have a medium value of preservation due to historical and architectural qualities.

Figure 1. Kjellerup Torv (kortforsyningen.dk)

Figure 2 shows the appearance of the contemporary interior of the block. An anonymous asphalt surface provides space for parking, with minor structures servicing the surrounding buildings with garbage collection, storage and private bike parking; a backside to the vibrant urban life surrounding the site.

Figure 2. Kjellerup Torv interior (own picture)

The appearance of the block from the outside, towards the waterfront is more interesting (figure 3). The block surrounding Kjellerup Torv is currently only completed by a low wall dividing the courtyard from the city. The municipality have a plan for redeveloping the wall and closing the block with a new building. The main street passing by, links the suburbs and the freeway to the inner city. It is an open space with benches and vegetation but, beside the visual connection to the buildings within the urban block, Kjellerup Torv is disconnected from this space.

Figure 3. Kjellerup Torv exterior (own picture)

The site provides an opportunity for rethinking how this historical and neglected site can be refitted into the city, and how it can re-assemble the surrounding urban and architectural space. In this way, the site itself is chosen because it supports the development of the tectonic attitude.

Examples of students' interpretation of the site

The interpretations put forward by students vary, depending on the prior investigations and the methods the students chose to conduct.
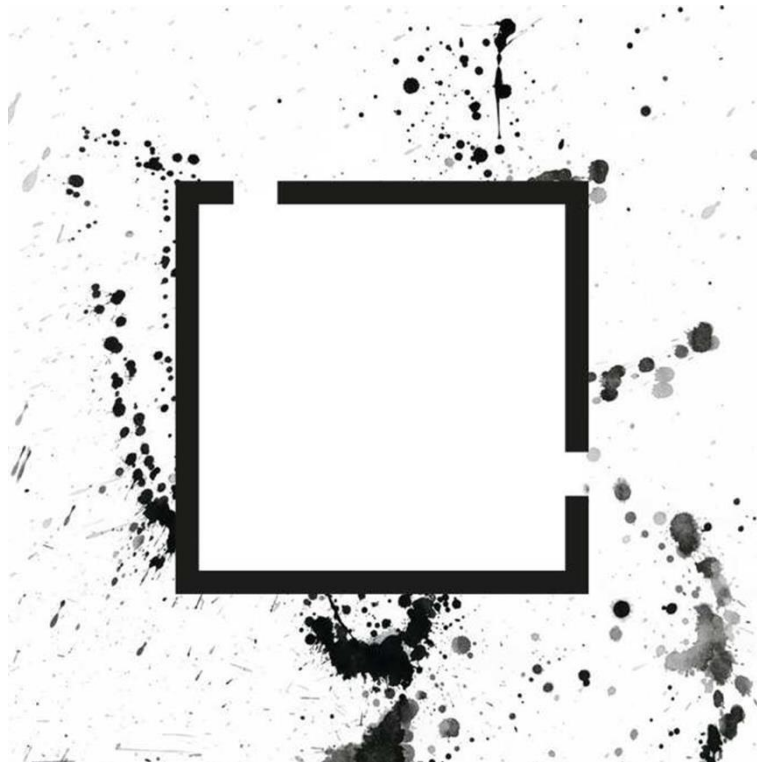
Figure 4. Christine Dalgaard

Christine Dalgaard interpreted the site as a calm square in the middle of a messy, noisy and vibrant urban neighborhood (Figure 4). This interpretation raises the question of whether to keep this atmospheric quality when re-developing the site, or if this atmospheric quality has to be changed for connecting to the surrounding context.
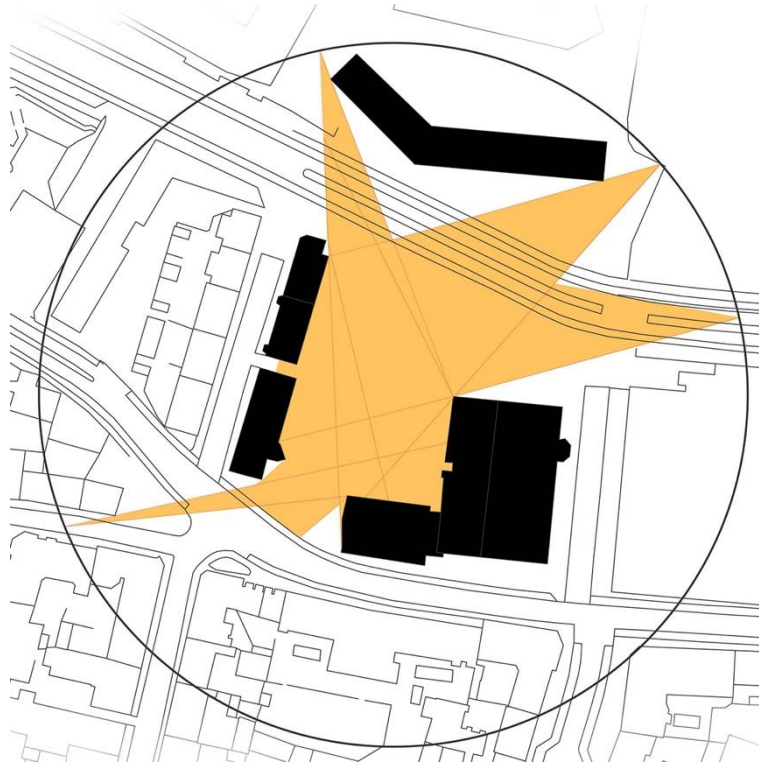
Figure 5. Emilie Nielsen

Emilie Nielsen mapped out dominating viewpoints from where Kjellerup Torv is visible from the context (figure 5). This interpretation indirectly captures the tension of a site visually not engaged with the city, framing the views as key positions for experiencing redevelopment.

Figure 6. Even Årsland Anderssen

Even Årsland Anderssen identified a feeling of wasteland permeating the site, by visualising a vegetation takeover coming through the cracks in the asphalt and walls (figure 6). He saw the site as exposed to a slow but firm integration of nature and culture, which introduces the question of how to build a project within this duality in the contemporary city.

These three interpretations of the site, in different ways, all reveal a critical reading of the site, relevant to a tectonic attitude. For the student's progression, the illustrations serve as a steppingstone between the analysis and the design phases. The illustration is the first interpretation of the design intervention, inspired by James Corner's quote *"Mapping is already a project in the making"[19]*.The illustration serves as a means for the students to identify their own interpretation of the site according to the context it is placed in. In that aspect, the illustration is an important tool for applying the

tectonic attitude, as the illustration becomes a tool for describing the spatial experience, or the interpretation of the site, which supported the subsequent modelling phase.

Moving on to the second part of the studio, the students are asked to do a conceptual design proposal building on their interpretation of the site.

Examples of student's conceptual design proposals

The students have two weeks for the model development, making the results conceptual, fast and experimental.

Figure 7. Christine Damlund

Christine Damlund made a design proposal of closing the block, and differentiated how the facades on a conceptual level engage the city on either side of the building (figure 7). Based on her interpretation of the site as an entrance to the inner city, she proposed a dominant, cantilevered building shape towards the street, with a subtle relationship to the bend in the opposing building on the other side of the street. As a composition, these buildings then constitute the image of an abstract gate structure to the inner city. On the courtyard side, the facade is withdrawn and terraced, creating a more intimate space exposed to the sun from the south. She continued the building volumes from the context, but still added individual character to her extension.
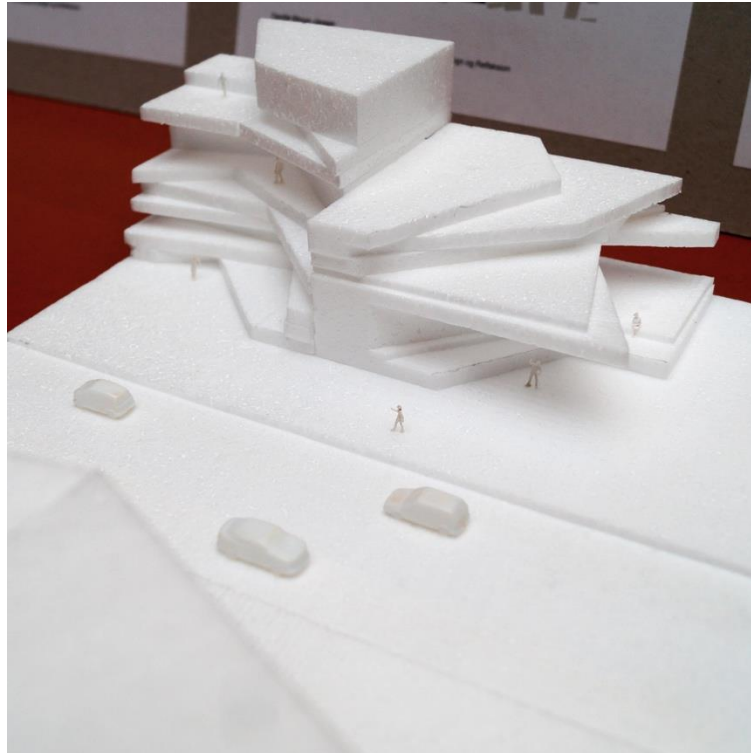
Figure 8. Cecilie Bruun Jensen

Cecilie Bruun Jensen responded with her design to what she saw as an anonymous infrastructural space, by focussing on the detailing of the facade towards the street. She worked with how a rather expressive and complex shaping of the facade can create different engagement and spatial situations, in contact with the adjacent sidewalk space. Her model shows an excerpt of her proposed facade detailing (figure 8).
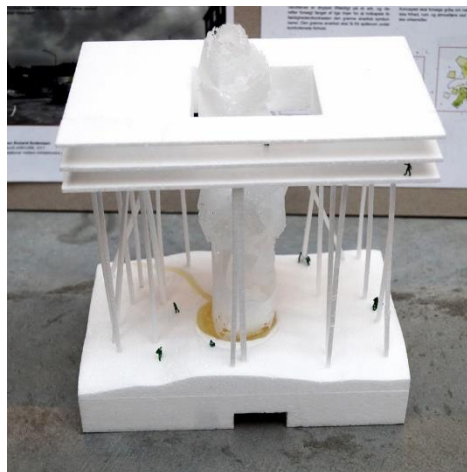
Figure 9. Even Årsland Anderssen

Figure 9 is a more conceptual design project by Even Årsland Anderssen, who built on his interpretation of the site as taken over by nature (figure 6). Even chose to work somewhat unrelated to the specific context, and experimented with creating a building typology, inspired by his interpretation of the site composed as an integration of nature and culture. He was experimenting with how a building on columns, integrated with a large tree growing up in the middle through a hole in the floor, could create an alternative urban atmosphere that combined culture and nature.

In three different ways these models show how a conceptual design of a building can be shaped in response to a critical reading of the existing urban situation. In this way the designs can be related to the tectonic attitude.

The studio concludes with an exhibition (figure 10), and time for collective reflections between students and teachers.

Figure 10. Concluding exhibition (Own picture)

CONCLUSION

Whether or not the effort in the studio has any effects on the students eventually developing a tectonic attitude remains to be fully explored. A design attitude grows over time but sparks of a higher contextual awareness in understandings and design, can be identified from a glance at the subsequent design projects from some of the students as they progress through their studies. Some students start to understand how their proposals fit into a greater whole in the city and seem to derive some of their design ideas from a reading of the context, and from how their design responds to that reading. They start to see the assembling of the building and the urban space, the new and the old, as a coherent architectural composition. Not all students do, but it is the hope that the seeds to such a development are sown during this studio, and that these seeds will grow through students' practice, and eventually have an impact on building culture, toward a higher awareness of the relationship between the experience of the city and how the city is assembled.

One of the challenges identified in the studio is that it seems to be difficult for students to excel in both the analysis phase and the modelling phase. It has usually been the case that students either have a good interpretative illustration, or a good model, but they rarely have both. This points to the potential of upscaling the efforts made in this studio, as it is a challenge for students to see the relationship between understanding the context and developing designs for that context. As a start, the following iteration of the studio, has extended the timeframe for the studio from 3½ weeks to 5 weeks. It is the aim of this extension to leave more time for reflection, and time for strengthening the connection between analysis and design.

The teaching associated with the urban tectonics development at Aalborg University has been growing over the last couple of years. It started out as a single workshop taught to 6. Semester bachelor students of urban design. In the current stage, it is included during the studio presented here. Eventually, it would be interesting to explore the theme in a full semester project with a higher level of detailing. In that aspect, it would be interesting to see how the tectonic attitude could be unfolded in more detailed designs, connecting also to the material aspect of tectonic theory. As the study of urban tectonics and its interpretation in pedagogical methods is ongoing, the notion will be refined through iterations of the studio and ongoing research.

ACKNOWLEDGEMENT

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INTEGRATING SUSTAINABILITY IN DESIGN STUDIO THROUGH BLENDED LEARNING

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INTRODUCTION

The complexity of sustainability often makes its integration into architectural education a difficult challenge. Consequently, sustainability is often not taught holistically or critically, leaving students confused as to what sustainable architecture is and how they might approach this themselves. At the same time, sustainable design must not be at the expense of our architectural imagination, yet within education and practice this is also often the case

This paper investigates how to bring sustainability knowledge into the studio instead of bringing the architecture studio to sustainability knowledge. In doing so, through two case studies undertaken at Aarhus School of Architecture, Denmark, the authors illustrate the integration of sustainable design in architecture studio using blended learning, such as making use of pre-recorded video lectures; group seminars, discussions and presentations; workshops and peer-peer learning as well as traditional studio drawing activities.

Changes within pedagogies need to occur to ensure that sustainability is embedded within the design education, acknowledging the dichotomy between the technical requirements and creative expression which are crucial for well-integrated holistic, sustainable architecture [1]. To embed sustainability in the architectural studio, both poetics and sustainability need to be taught together, focusing especially on the aesthetic and spatial implications of sustainability. The key to integrating sustainability in the architectural studio is not only to give knowledge but to ensure that specific learning activities allow for the application of this knowledge into students' design process as well as to discuss the implications of this knowledge for the students' own design project and the subsequent architectural language. This supports deep learning, critical thinking, and reflection skills. In the two cases outlined in this paper, this incorporation was embedded through developing studio-specific learning activities that cover both architecture and sustainability aspects, with students completing in-depth investigations and mappings of exemplary sustainable architecture case studies.

BACKGROUND

Sustainability in the design studio

Sustainability has been taught within the architecture curriculum for many years, however often parallel to 'traditional' design studio and in some cases in conflict as a technical or engineering

specialization – often taught as lecture-based elective classes [2]. Sustainable architecture has only recently shifted from this specialist position to a central concern of architectural education. However, there is still work to be done to ensure pedagogies fully embed sustainable architecture into the architecture curriculum, especially within studio environments [3].

Architecture studio is based on 'making'[4] and problem-based learning, i.e. experiential learning through learning by doing [5], through reflective practice: students are "*thinking what they are doing, while they are doing it*" [6] However, as Schön posited, there is a design education paradox: initially students cannot understand what designing means as they can only learn this through the actual experience of designing: only by doing does a student learn it, and only then do they require the capacity to design [7]. Furthermore, Altomonte elaborates that design studio serves as an environment for synthesizing bodies of knowledge which are often delivered within parallel didactic areas [8]. While it is assumed that these fundamental principles and theoretical knowledge will be used to guide and inform students' projects, often this information is completely isolated from its design context [9]. Resulting in students rarely engaging creatively with this knowledge and integrating, in this case, sustainability in their design process.[10]

Integrating sustainability

To support students learning of sustainable architecture, new pedagogical methods need to be implemented within the architecture curriculum [11]. It is recognized that sustainability issues need to be incorporated early on in the design, yet sustainability is often excluded in architectural design studio due to lack of knowledge by design tutors.[12] Design tutors are usually trained architects with some architectural practice experience. They typically teach through individual tutorials to guide, question, discuss and demonstrate [13], often supplemented by lectures, or seminars, typically held in more formal settings outside the studio space. Improvisationally, the tutor demonstrates designing and design processes, by drawing different possible ways of designing, articulating the moves being made and why. As the focus is on teaching students how to design through reflection in action, some fear that by adding sustainability to an already broad architectural curriculum will distract from design skills, and might lead to superficial knowledge only.[14] As such, there is a lack of sustainability issues being considered in students' projects, and, by extension, in the real world.

Where sustainability aspects are considered, they are often 'bolted' on at late stages, preventing the integration of sustainability in design [15]. Yet sustainable design not only contributes to a better built environment but can also enhance instead of inhibit creative solutions in design projects [16]. Moreover, given the climate emergency, integrating sustainability has become an extremely crucial part of the design process [17]. Hence both Hagan[18] and Donovan [19]argue that sustainability needs to be brought into the design studio. This opportunity arose at the Aarhus School of Architecture, where a new 'Emerging Sustainable Architecture' teaching and research programme was developed, encompassing around 120 undergraduate and graduate architecture students and a team of 10 design tutors with different areas of expertise within the field of sustainable architecture. Through discussion, the curriculum was revised to embed sustainable thinking from the early stages of students' education and design projects.

Blended learning: a solution to integrating sustainability in the design studio

Blended learning is a hybrid teaching method using different ways of teaching and learning. Typically, it is considered to include a combination of e-learning with conventional face-face classroom methods (e.g., where direct interaction is of most benefit), and independent study of the

material provided by e-learning (e.g., pre-recorded lectures that the student can watch in their own time) [20].

The blending of our teaching and learning activities was motivated to allow more technical knowledge to be delivered outside face-face time for deeper reflection and (peer-peer) guidance in between classes, while using the classroom time for testing, reflecting, discussion and the application and integration of sustainability knowledge into the creation of new ideas, guided by tutors. There might also be other benefits to blended learning, such as increased student engagement and satisfaction, and deeper learning might support better average class grades [21]. Other learning outcomes might also be supported; for example, in one study, students felt it helped them improve presentation and discussion skills and was especially helpful in the early and final stages of the design process [22]. However, another study indicated that satisfaction was higher for face-face learning, compared to blended learning (that included face-face and online modules) [23]. Other studies have also highlighted that students dislike technology-heavy courses, or when there is a lack of face-face contact, even if their overall grades improve [24]. These studies suggest that blended learning needs to be implemented critically and with careful consideration of the desired learning outcomes and student expectations.

METHODS

A hybrid of teaching methods (i.e., blended learning) were used to encourage active student engagement with their learning; to support using the best method for different learning outcomes; and to recognize that using different methods not only reflects the diversity of how students learn [25] but also the types of sustainable architecture they produce. Learning by doing workshops, which utilized blended learning, were the main pedagogical methods used with the aim to integrate sustainability in design studio, according to the following Bloom's revised taxonomy of learning objectives [26] (illustrated in Figure 1):

1. Providing general background sustainability knowledge, through students listening to lectures (including pre-recorded videos), reading, discussion (Bloom: remembering, understanding, analyzing)
2. By 'thinking like an architect'27, i.e., to make connections between sustainability knowledge and problem-based scenarios through applying the knowledge, analyzing, and evaluating case studies (Bloom: applying, analyzing, evaluation)
3. By 'reflection-in-action'28, i.e., not every problem has a right answer or is solved by simply following 'rules.' Students construct and test new understanding, strategies, and framing of problems by generating new ideas (through text, and drawing). (Bloom: creating and through reflection also analysis and evaluation of own ideas)

The above is in support of bringing sustainability knowledge from the lower levels of learning to the higher levels of learning [29] i.e., in the creation of design projects. Specific pedagogical methods are discussed in each case study; however, peer-learning was also fundamental in the case studies, as described elsewhere.[30]
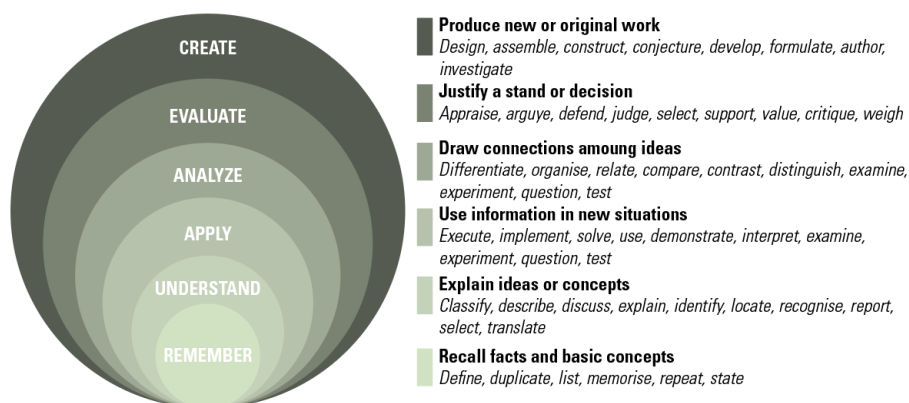
BLOOMS TAXONOMY

CREATE

EVALUATE

ANALYZE

APPLY

UNDERSTAND

REMEMBER

Produce new or original work
Design, assemble, construct, conjecture, develop, formulate, author, investigate

Justify a stand or decision
Appraise, arguye, defend, judge, select, support, value, critique, weigh

Draw connections amoung ideas
Differentiate, organise, relate, compare, contrast, distinguish, examine, experiment, question, test

Use information in new situations
Execute, implement, solve, use, demonstrate, interpret, examine, experiment, question, test

Explain ideas or concepts
Classify, describe, discuss, explain, identify, locate, recognise, report, select, translate

Recall facts and basic concepts
Define, duplicate, list, memorise, repeat, state

Figure 1. Summary of Bloom's Taxonomy adapted from Armstrong [31].

CASE STUDIES

Two case studies were conducted in 2018 at Aarhus School of Architecture to investigate how to embed isolated theoretical information of sustainable architecture within the studio environment. This was done through the development of creative studio-specific learning activities that covered general architecture and sustainability aspects. In the following section, the specificities of each workshop are described; however, typically, learning was blended by making use of:

- pre-recorded video lectures,
- group seminars and discussions, with peer-peer learning and feedback throughout (as described elsewhere [32])
- workshops (with 'roaming' tutors on hand to discuss, explain, and guide)
- in-depth investigating and mapping of exemplary sustainable architecture case studies
- traditional studio drawing activities
- Classroom Assessment Techniques were used for students to reflect on their own learning (and to help guide tutors on any issues arising). This was in addition to the collection of student feedback.

CASE STUDY 1: COMMON SUSTAINABILITY WORKSHOP

An introductory workshop was developed to upskill around 95 students – both graduate and undergraduate – on the topic of sustainable architecture. In addition to increasing awareness and knowledge, we strived for all information and principles to be explored within the context of design, thus integrating and embedding sustainability within the studio environment.

Specific content related to three different themes:

- What sustainability means
- Approaches to sustainable architecture
- Drawing sustainable architecture

Each of the three phases were designed with different levels of blended learning, depending on the content and level of student engagement needed. The first exercise aimed to help students form common, broad-spectrum understandings of what aspects may be addressed within sustainability; establishing a common language and definition of what sustainability may mean within the teaching programme. Students were given short lectures but primarily utilized the ARUP 'Drivers of Change'

cards [33] and their e-resources to facilitate discussions in small groups and presentations to the larger group, thus, situating and applying concerns to their regional context, creating a deeper awareness of the topic.

The second exercise aimed to introduce different approaches (theoretical knowledge) to sustainable architecture, to help students become familiar with the key concerns, concepts, and principles for a specific approach, increasing awareness of the many different ways in which sustainable architecture can be practiced. Students utilized lectures (from staff), pre-recorded lectures (online), group discussions, physical mapping in groups, peer presentations, and physical mapping in teams to reflect and translate theoretical knowledge into physical principles critically.

The third task was divided into two parts, the first, aiming to give insight into how a building uses design solutions to address concerns of sustainability. Students worked both in groups and individually to produce two drawings. The first hand-drawing was a collection of documentation and analytical drawings of a different assigned building accompanied by a short critical written reflection considering the sustainability success and failures of the given built example. Lastly, each student produced a creative drawing which visually represented their personal critical written reflection or position, synthesizing the information from the first tasks into critical self-evaluation and design forms. Throughout, blended learning was utilized to support learning by doing through the use of online resources and lectures, group discussions, peer learning, drawing, normal studio-based- and peer-peer learning.

CASE STUDY 2: MASTERS SUSTAINABILITY WORKSHOP

In the Masters sustainable architecture studio, 12 master's students from 4th and 5th year took part in blended learning activities with the aim to improve sustainability knowledge, and to integrate this knowledge in students' own design projects, which were at conceptual stage (i.e., apply, analyse, evaluate, create; higher learning in Bloom's taxonomy, see Figure 1).

The specific focus related to building-scale solar energy: its energy and CO_2 reduction potentials and its aesthetics. Delivery of content was blended and consisted of 15 to 30 minutes pre-recorded video lectures by the tutor (see Figure 2.); flipped learning (i.e., seminar after watching video lecture); group work and presentations; workshops with peer-feedback/discussion; and individual tutorials to support individual design work.
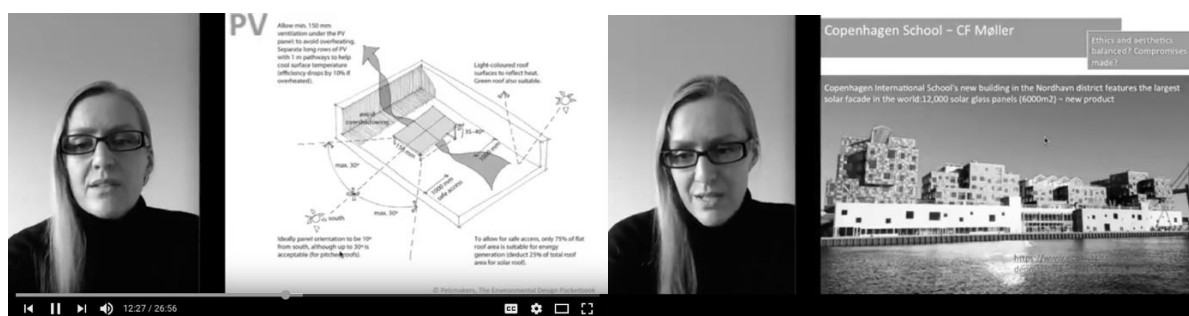
Figure 2. Screengrab of pre-recorded background lectures, focusing on both quantitative, technical knowledge, and its application and evaluation in built cases.

In the pre-recorded content, the design tutor practiced and demonstrated 'reflection in action' by analysing and evaluating the use of solar technology, and potential technical and aesthetic implications through different case studies (see Figure 2). In self-selected pairs, students practiced the same for other built cases, and communicated their analysis and evaluation to the rest of the group.

Peer-peer learning created a safe environment for discussion, reflection and sharing (as described elsewhere [34]), including students positioning themselves about the aesthetic implications of solar technology in different case studies. Peer-learning also supported in-class workshops, where students learned to select the most appropriate solar technology for a given case study, and to calculate the energy and carbon footprint of the case, before and after solar technology application. The tutor 'roamed' the classroom to guide, demonstrate, check, and question each student's (and group's) understanding and progress. The final evaluation of the case study and its results were communicated to the group as a workshop summary by the tutor, followed by a discussion of the case, and reflection on the learning process; this content was screencast recorded, for students to refer to if needed.

Finally, students – who already had an individual design concept and functional programme – started to apply their new knowledge to create new ideas in their design projects, and how this influenced their design (aesthetically and conceptually). Traditional desk tutorials supported this, and students included this in their project's design realization report. Anonymous Classroom Assessment Techniques (CATs) were used at different stages for students' reflections on their own learning; this also supported teacher reflection.

Reflections of both cases

The use of blended-learning, learning by doing, and peer-peer learning successfully helped students to understand the complexity of sustainable architecture, integrating theoretical and empirical information within the studio environment. Blended learning allowed the design tutors to focus on the higher learning outcomes in face-face interactions, through a mix of workshops, peer-learning, and feedback, as well as traditional tutorials. It required the tutor to reflect in action to allow for 'live' adjustments to the teaching plan were needed to reflect the dynamic nature of interactive workshops. Aside from some practical issues (such as the online learning platform requiring significant compression of videos), the interactive, blended learning activities supported student engagement with the content and its application in their design. However, given the departure from traditional face-face tutorials, better clarification of expectations and reasons for the blending of learning would have been useful to reduce initial confusion among students about this way of learning. Moreover, blended learning successfully supported the 'learning by doing' sustainability workshops with active student participation, but it is unclear if blended learning would be similarly satisfactory without workshop activities.

CONCLUSION

Architectural education still uses the design studio as its main tradition [35], and for decades design studios have remained very much the same, where the master-tutor model of individual tutorials and design reviews are the main teaching methods. However, decreased teaching resources, combined with growing knowledge demands and increased complexity of building design, traditional studio teaching is becoming more difficult, and blended learning may be a solution to support these pedagogical struggles.

We used blended learning to integrate sustainability in the design studio, at three levels of learning: background sustainability knowledge, "thinking like an architect," and reflective practice for the creation of new ideas. This was done through pre-recorded lectures, group work, peer feedback and discussion and practical, interactive workshops where students learn by doing, through interactions with tutors and peers. This engaged students with sustainable design through different, collaborative activities that supported reflective practice and more in-depth learning, embedding sustainability in design-thinking.

Our role as teachers was to get students to accept and use the technicality of sustainable design as part of their creative reality, and to demonstrate that sustainability is not only desirable but essential for creative design approaches. This is necessary because sustainable design is no longer optional and is part of the architect's new required professionalism.[36]

On a practical level, by introducing blended learning activities, it is essential to:

- **clarify** the role of tutors to both colleagues and students, i.e., that of facilitator or initiator of activities at these moments, not as design tutor. This is important, especially when the blending of learning is a new method, and both students and teachers are not familiar with it.

- **build cultural change**: there is a move from the traditional methods to combing with the blending of methods; tutors need to be more explicit about this to manage expectations and to establish a broader learning community and culture built on open sharing and a collective spirit.

- **review and reflect** i.e., plan ahead, but tutors to allow space for adjustments to encourage opportunities for collective reflection and exploration, which develops organically and is hard to plan for.

The blending of learning encouraged the application of sustainability knowledge into the creation of new ideas, but it also supported other skills that are not usually a primary focus in the design studio, e.g., project and learning management skills, group communication and collaboration, reflecting the reality and needs of architecture practice. Moreover, students were exposed to other students' thinking, learning, and design processes, and learned that there are different approaches to integrating sustainability in design, based on different priorities and interpretations; this was also notable in the studying of actual exemplary built projects and different architect's approaches. **Finally, by placing sustainability content in the studio, it elevated sustainable design issues, usually considered secondary.**

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CASE STUDY RESEARCH DESIGN AS A FRAMEWORK FOR LEARNING IN ARCHITECTURAL EDUCATION

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INTRODUCTION

Over the past decade, architectural education in Denmark has gone through significant developments, reflecting contemporary societal and political tendencies. At the Royal Danish Academy of Fine Arts, School of Architecture (KADK), the school under study in this paper, these changes have caused important structural and pedagogical adjustments. Established in 1754 as part and parcel of the Academy of Fine Arts, it is a school based on the Beaux-Arts tradition, holding a focus on developing the candidates' conceptual design competencies and artistic identity. Although the esteem of the graduates has kept up, the school's governmental subsidies has gone through reduction in recent years, reflecting the students' indicative difficulty of getting foothold on the job market[1]. As teachers at the school, our experience is that the students have limited understanding of the conditions at the market for building design and of the collaborative dimensions of their upcoming work as architectural designers. A central characteristic of this market is the request for architects, not only to be able to sketch, but also to argue for and explain the organization of their work and their conceptual ideas in writing.

Below we address one educational initiative at KADK, a mandatory 3rd year BA-course called "Forms of Practice" that ran from 2014 through 2018. It is built on ideas that reflect the contemporary tendencies and is structured in accordance with didactical changes within the setting of higher education in Denmark. An important adjustment in this respect is the transfer of the architectural educations from the Ministry of Culture to the Ministry of Higher Education and Science in 2011, followed by an increased focus on the faculty's scientific production and ability to organize research projects. This relocation produced new regulations of the training, e.g. introducing the notion of "learning objectives" and "research-based teaching"[2] to organize coursework and categorize its outcome. As a result of these changes, a model to establish the school's institutional understanding of knowledge was developed in a top-down process. Entitled "the educational triangle"[3] it divides the approach to knowledge into three cornerstones of artistic knowledge (art), practice knowledge (practice) and scientific knowledge (research). The link between these three is at the core of the challenges we experience in the development and implementation of "Forms of Practice."

The course aspiration is to enable students to access knowledge of architectural practices through the exploration of qualitative case studies; to train their ability to explore professional issues, and to

articulate these insights in a reflexive manner. Through questions such as 'where does architecture come from?' and 'what are the processes behind the design?', the purpose is for the students to analyze practical aspects of professional architectural work. The involved teachers provide lectures on case study research design and practice theories (see table 1) and introductions to the terms of collaboration in the building industry – as implements to explore practice and to produce a written report. Parallel to these inputs, the students are given a case and 1-2 informant(s) from the case project, as the point of departure of their exploration. Our findings suggest that while KADK's preconditions for providing this course initiative seem contested, the students appear to obtain significant writing skills and analytical capacity. Below we offer a few considerations to explain these points.

LINKING RESEARCH AND TEACHING

As KADK is based on the Beaux-Art tradition, the tendencies referred to above become unavoidable challenges in organizing the school's educational program. To understand this development and the challenges they produce, we draw on studies focusing on the link between research and teaching in higher education. Healey[4] notices that the ideas behind and significance of this connection is internationally discussed and emphasizes that the topic's complexity and various interpretations may challenge its application. While most of this literature is distinctly aimed at academic university environments, the requirements placed on KADK is increasingly resembling these university contexts. Regarding the meaning of "research-based teaching", Healey[5] suggests examining a model spread between two axes: A student focused versus and a teacher focused teaching environment, and a focus on research content versus research processes. Between these are subcategories characterizing the format for and organization of the teaching. The approach applied at "Forms of Practice" is categorized as "research-based" as it is oriented towards students as well as towards research processes. The work of the students is "inquiry-based", reflecting their involvement in a research-related context and by a research-related approach. The overall characteristic of this approach to teaching is that the students not only receive new knowledge, but they also create knowledge through active participation6. Our experience is that there is a vague perception of the ideas behind "Forms of Practice" at the school, and of what it takes to organize and implement such a course. A point we initiate in the preliminary discussion below is that when the conditions for architectural education change, the need for discussing the profession's didactic foundation is strengthened[7].

METHODOLOGICAL CONSIDERATIONS

In this section we briefly outline "Forms of Practice" as context for our study. In table 1 we provide an overview of the organization of the course and our engagement with it.

"Forms of Practice" ran for the first time in 2014, involving real-life cases as contexts for group study explorations and resulting in a written report. In 2015 and in accordance with basic ideas within case study research design and relevant theories to support the students' analytical capability, the course ran with lectures and a syllabus of texts. Working with a real-life case in groups, the students collectively produced their "case study" as a written report.[8]

Forms of Practice

Year	2014	2015	2016	2017	2018
Staff	5 supervisors, of which 2 were researchers	9 supervisors, of which 3 were researchers	8 supervisors, of which 4 were researchers	3 supervisors, of which 3 were researchers	3 supervisors, of which 2 were researchers
Author 1	Invited to comment on the student reports with business school colleague	Lectures on theory and method with business school colleague	Lectures on theory and method with author 2	Lectures on theory and method with author 2	Lectures on theory and methods alone
Author 2	Supervisor	Supervisor	Supervisor Lectures on theory and method with author 1	Supervisor Lectures on theory and method with author 1	
Literature on research interview	X	X	X	X	X
Literature on case study design		X	X	X	X
Literature on academic writing and methods		X	X	X	X
Practice theory, Donald Schön	X	X			
Role Theory, Erwin Goffman		X	X	X	
Narrative Theory			X	X	X
Actor-Network Theory			X	X	X

Table 1 provides an overview of the involved methodological and theoretical components as well as our involvement in teaching.

Our data mainly draw on documents and participant observation. As teachers, we have taken notes, discussed course content and pedagogical principles over email and in meetings – together and with fellow teachers and supervisors involved in the course. We have followed the running production of documents involved in the course development, e.g. course descriptions, minutes from meetings with supervisors, yearly changes in the syllabus, and so on. As our research interest reflects a course at an educational institution, we consider our work as a type of participant observation in "a natural environment."[9] Our participation has varied over the years of involvement, attending the course as teachers, supervisors and observers of the teaching of colleagues[10] (see table 1).

FINDINGS

We present our findings in two parts. The first part presents the school's as context for providing this type of educational initiative while the second presents an example from a student report to display the students' output, exploring and analyzing practical aspects of professional architectural work.

The school as context

The development of the course has been subject to several controversies. A central challenge has been to establish a mutual understanding of where the course should be positioned in relation to "the educational triangle" mentioned in the introduction (see model 1). This positioning is a central component in the staffing of teachers and supervisors, the curriculum planning, the process of presenting the course to students, and in relation to the organization of course activities.
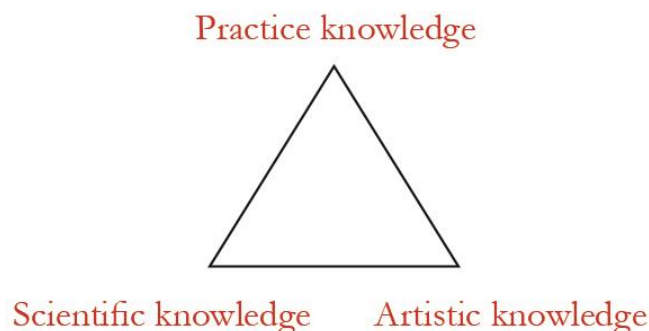
Model 1. "The educational triangle."[11]

Rector initially saw the course as part of the school's "practice leg" referring to the educational triangle, presumably considering the course as a way for students to qualify their coming choice of a career by introducing them to different professional design contexts. To other representatives of the management, the course was considered a lever to "heightening the school's academic level", considering whether the course "is – or could become – research-based" (internal email, 2015). Representing this position, the head of school suggested the course as a platform for the students to strengthen their "critical reflection based on a research approach, further developing their knowledge about the professional practice context."[12] While the three legs may all be involved in the course, the scientific and practical legs, and the reciprocal relationship between them, are at the core of its organization (see model 2).
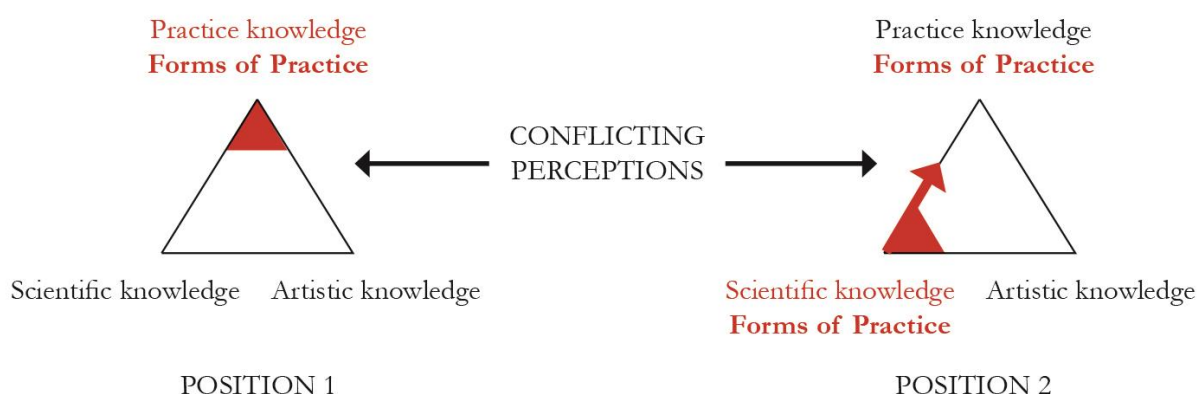
Model 2 illustrates how the diverse positioning of the course representing controversy at the school, in relation to the triangle.

A challenge involved in this setup is that several supervisors, who help the students in approaching and comprehending the case, are practitioners themselves and not researchers. Although this can be considered a strength as a core focus on the course is to understand practice, it is also a weakness when the supervisor is less informed about the course didactics than the students. As some of the supervisors/practitioners attended the lectures and some did not this has been a continuous concern by organizers as well as students:"[O]ur supervisor was not able to help us when we were challenged by writing the report, even though we pointed out this was the hardest part for us" as one student points out (student evaluation, 2015.)

In continuation of this challenge and returning to the position(s) outlined in model 2, the course has been subject to substantial debate at the school, highlighting issues such as the relevance of theoretical analysis and writing skills for students of architecture, the students' ability to handle the situation of interviewing professional architects, the relevance of involving teachers from other institutions, to mention a few. The – presumably temporary – end to these discussions has been to merge "Forms of Practice" with KADK's new mandatory BA-Internship course. The course has thus been closed, even though much of its content continues in a different context.

Student insights

Examining the student reports from 2014 through 2018, we may consider the potential insights (knowledge, skills, competencies[13]) the students gain from attending "Forms of Practice". They acquire *knowledge* about key aspects of architectural design practice, e.g. the organization of the different phases and actors involved in construction projects; the relationship between the architect and the client and users; the implementation of digital technology, and they are introduced to the broad scope of an architect's services within a project context. They obtain *skills* in applying qualitative research methodology to collect data supporting the inquiry, e.g. through semi-structured interviews and document analysis. They *acquire* competencies in organizing and conducting a case study; setting up and preparing for interviews with informants, as well as writing a report where they draw on both practice theories and methodological techniques. Many groups seem to have difficulty in applying the theory in the discussion of the data instead of explaining the theory and 'merely' referring to it implicitly. However, every group demonstrates attempts at this, and the theoretical ideas seem to support their understanding of the professional dilemmas at stake in the practice in question. Below we provide a brief example from one student report:

Using the transformation of a train station as their case, this group studied the competition brief and the winning office's project development through document analysis, interviews and public reviews. The following excerpts are examples from their analysis: "We asked ourselves how architects are influenced by narratives in their practice, and how their role as mediators are played out. […] We found that different narratives have not only been motivating for the design development, it has also functioned as a tool to disseminate the project" (students report).

The students find the narratives to function as a tool in the project development – in the architects' work on the design and in the efforts to convey the project to others. Their study shows that the narrative is a co-designer in the process, and that the narrative itself become a design task, which is not material but has material outcomes. In the following quotes, the group summarizes their analysis: "These narratives can be considered as given to the architects [through the brief], which they interpret and further elaborate through their design solutions. We illustrate how the architects acquire the client's vision of an efficient and user-friendly train station, addressed in the competition through the key concept "smooth travel" (ibid.)

The group points out that the client puts forth a task with already existing narratives, which the architects "interpret and further elaborate" through their proposal. The statement also shows how to apply professional terms such as "key concept", even though they are not interested in what constitutes the key concept in this assignment, but how it is created. "[Our analysis] showed how the architects create their own narratives through the use of visual diagrams, highlighting transparency, light and safety as central themes. […] These narratives worked as a driver in shaping the design of the lighting, the buildings and the fixtures. The visuals help the architects emphasizing the atmosphere they want to establish with the new station. By representing a distinct shift in relation to the old station, the visual narrative become a tool in proving the quality of the project" (ibid.).

The students observe that the narratives work at different levels. They are strengthened by for example the visualizations in the project, which contribute to create a new identity for the station that is accentuated by being different from the (narratives of the) old station. In their discussion, the group paves the way for a broader discussion of the meaning of narratives in architectural design: "We have been able to conclude that narratives have a great influence on [architectural] practice. Based on our studies, we can see that a number of other architectural offices also use narratives to a greater or lesser extent, and within our group we have discussed what impact this has on the professional practice. Can the narrative become too controlling for a project?" (ibid.).

The group concludes that the case organization and project context are strongly influenced by narratives, and that their study shows how an increasing number of other projects also use narratives as a driving force in the project development. They highlight one well-known project, in which they estimate the narrative to be better than the actual architectural project, asking whether narratives can become too strong potentially compromising architectural quality.

PRELIMINARY DISCUSSION AND CONCLUDING REMARKS

We have illustrated a few challenges involved in introducing "Forms of Practice" to a school based on an artistic foundation. KADK is well known for developing candidates with strong conceptual skills, not only in the professional community and by the students, but also among the general public. For many of the students it is surprising and somewhat frustrating to be confronted with a course about architectural work and the dilemmas involved in the practice as their expectations are to learn how to develop conceptual approaches to architectural design. It is also challenging for teachers and supervisors – those who are researchers, but not least the practitioners, affiliated part-time to the school. This is an interesting paradox involved in our study: While the school has a strong connection to practice through the many practitioners involved in studio-teaching, these teachers are challenged by supervising the students in analyzing and articulating the practical dilemmas in a reflective and argumentative manner.

The excerpt from one of the groups' analysis of the process of designing a train station provisionally illustrates how the group applies ideas from narrative theory to explore conditions for the design development. It makes them question important compromises in the process of materializing the architectural design ideas. Our data shows that the methodological and theoretical constructs presented during coursework are (tentatively) applied by the students and that the process of writing the report seems to train their ability to identify and articulate dilemmas in their upcoming field. They learn to explore and unfold – to analyze – conditions behind the practice. While this capability is somewhat different from the ways of thinking about and handling constrains in architectural practice predominantly in focus of their education, it also holds parallels. Analysis means to collect and disassemble data about a given case to then focus and reassemble the ideas produced in the process to form new understandings or solutions[14] e.g. the shape of an architectural design.

The controversy embedded in the positioning of the course in the school's "educational triangle" has unfolded at the management level as well as among faculty and the external teachers. We suggest that the implicit tension between three "legs" or approaches to knowledge is at the core of the institution's current challenges, and that "Forms of Practice" is an interesting representative of this conflict. It reflects the education's link to the profession's raison d'être by its focus on practice, while at the same time emphasizing its close connection to the requests of the market. Despite these unsettlements around the pedagogical framework of the course, it seems clear that the students obtain significant insights. Had the course continued, one suggestion would be to involve this controversy in the

dilemmas handled in the course. We consider "Forms of Practice" to be a relevant setting for discussing the profession's didactic foundation.

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A DELUSION OF INNOVATIONS? AN EXPLORATORY STUDY INVESTIGATING MICRO-LEVEL BARRIERS TO AN EFFECTIVE MACRO-LEVEL BIM DIFFUSION

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INTRODUCTION

Widely articulated evidence has documented numerous failed reform attempts to overcome inefficiencies and give way to effective innovation within the Architectural, Engineering, Construction and Operation (AECO) sector[1,2,3]. To stimulate effective change, a radical, robust and achievable innovation was required for the entire sector to adopt. Therefore, as a response to other sectors enjoying wide-scale productivity and efficiency gains from embracing digital technologies, Building Information Modelling (BIM) emerged within global agendas as a potential solution to industry stagnation.

Why Adopt BIM?

The acceptance of BIM presents many challenges for the AECO sector. Notwithstanding the seemingly industry-wide recalcitrance towards effective culture change, the UK's Government Construction Strategy 2011 found that the sector has failed to exploit growth opportunities, particularly in terms of adopting digital technologies[4]. This is supported by data measured by the McKinsey Global Institute's Industry Digitization Index[5] which suggests that the construction sector is lagging behind all other sectors in its relative level of digitization; it features last out of twenty-two sectors within Europe[6] and comes second bottom only to agriculture and hunting in the U.S.[7]. This is despite evidence demonstrating that there is a positive relationship between digitization and productivity. For example, at a local level, ICT-intensive businesses tend to enjoy beneficial business process changes and higher levels of productivity[8]. At sector level, the Industry Digitization Index suggests investment into digital technologies would provide a significant portion of the much-needed productivity gains[5].

BIM purports to use the fundamental principles of integrating *people*, *processes*, *policies,* and *technology* to deliver quantifiable savings[9,10]. BIM leverages effective information management, enhanced stakeholder engagement and parametric modelling to deliver data-driven outcomes, thereby overcoming problems caused by low-quality, unstructured information[11]. Empirical evidence is beginning to demonstrate BIM's contribution to in increased productivity and reduced failure costs across industry[12] and although less quantifiable evidence exists surrounding BIM's contribution to

lower emissions, "*only through the implementation of BIM will we be able to deliver more sustainable buildings, more quickly and more efficiently*"[13].

Environmental benefits, such as the improved sustainability credentials of built assets, are most valuable when considered within the context of the wider built environment. Yet, as with past efforts to achieve industry reform, best practice has traditionally been restricted to pockets of excellence rather than becoming business-as-usual for the wider sector[3]. This suggests that an effective sector-wide adoption of BIM is required to not only deliver the much-needed industry reform, but to also produce a cleaner, more sustainable built environment.

BIM Macro-Diffusion in the UK

When considering the adoption of any innovation, we can approach it as either the successful adoption by an individual or organization at the micro- or meso-level respectively – i.e. the implementation of an innovation – or the successful spread through a population at the macro-level – i.e. the diffusion of an innovation[14]. To date, a significant amount of the work has focused on the adoption of BIM by organizations. Recent developments within BIM adoption research have also been concentrated on applying behavioral theory typically used in information systems research to understand micro-level implementation[15]. However, whilst assuming these levels of analysis provides rich insights, understanding macro-level mechanisms has been much less developed and yet is crucial to understanding the effectiveness of policy in achieving widespread diffusion.

Therefore, with amounting pressures growing for national governments and their AECO sectors to implement BIM, literature is demonstrating a global interest in understanding why, how, and to what extent BIM is diffusing within countries and across continents[16,14]. Like many other nations, the BIM rhetoric in the UK is being expressed primarily through a *top-down* dynamic[17]. This positions the government and public clients as the change agents for BIM diffusion[18]. Macro-level metrics developed by Succar and Kassem[14] position the UK as a well-established pioneer in strategizing BIM diffusion when compared to other countries. Applying the conceptual tools developed in an earlier paper, Kassem and Succar[17] found the UK to be the most mature out of 21 nations worldwide when scored against a series of "macro-maturity components". A report commissioned for the Scottish Futures Trust (SFT) substantiates this position, identifying the UK as one of earliest to engage in BIM policymaking activities[19]. Moreover, the report highlighted that the UK benefits from high levels of BIM-related innovation and research, high levels of industry engagement, standards which assume a holistic approach to projects, and a pan-sectorial communication strategy.

This central approach to diffusion is not without criticism; a risk of non-uniform adoption exists which is favorably weighted to larger organizations and those who regularly take on public-sector projects. Yet, without empirical evidence, it is difficult to validate whether such patterns are indeed occurring and if so where to focus remedial action and resource. However, there is also an absence of academic-led, evidence-based research when considering BIM adoption at the macro-level[20]. Rather, the gap is presently being bridged by a plethora of industry-based, commercial reports and surveys[21]. Whilst not methodologically rigorous and oftentimes without theoretical grounding, such surveys can only provide indicative adoption rates from a longitudinal perspective in addition to providing an adequate departure point for academic research to build upon. However, such commercially-driven surveys benefit from heightened exposure and resource, enabling larger sample sizes than those typically achieved in academic studies.
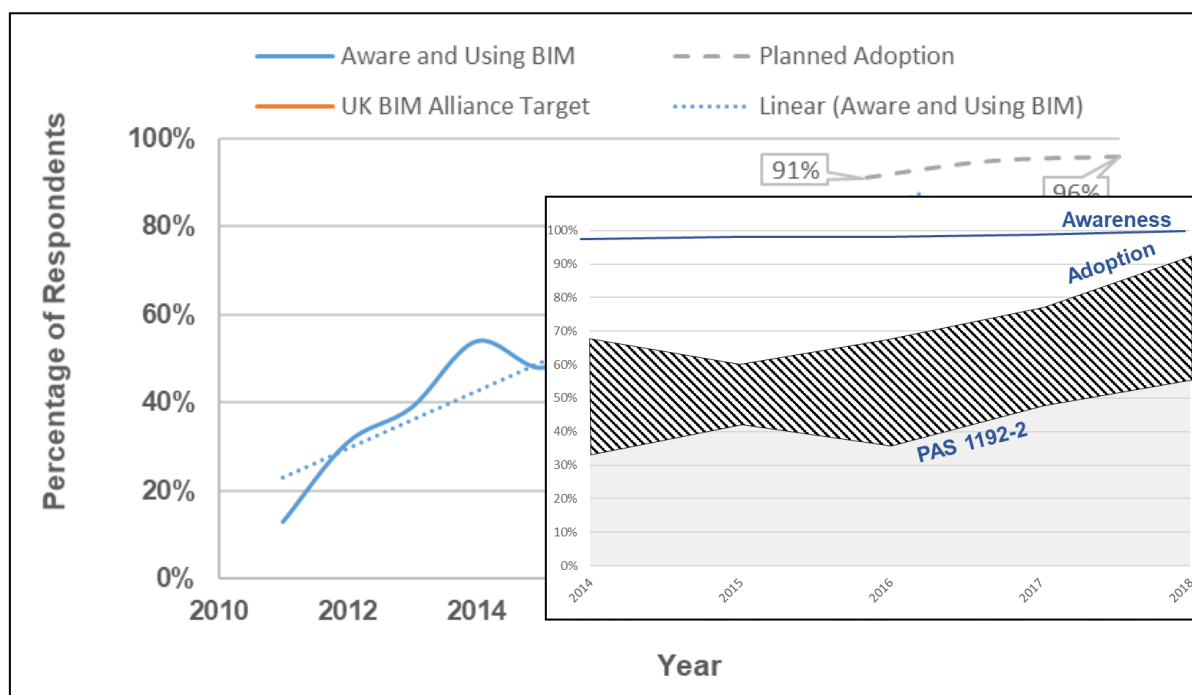
Figure 1. BIM Adoption in the UK. Data from the publicly-available NBS National Reports.

In the UK, the leading BIM adoption survey is conducted annually by the National Building Specification (NBS)[22]. From the outlook displayed by the National Surveys, as illustrated in Figure 1, it can be summarized that BIM adoption is positively trending. When compared to the 75% by 2020 target established by the UK BIM Alliance, the overall trend indicates this target will be met[23]. However, the curve doesn't represent a clean growth and has suffered dips, including within the latest edition of the survey. The ambition is evident, but whilst barriers still exist for effective implementation, targets may not be realized as intended and adoption levels may stagnate.

However, a government-supported, top-down driven innovation is advantageous for endorsing initiatives to support adopters based on the process, policy and technology constituent elements of BIM. For example, as a source of external pressure, the barrier of low business priority can start to be removed for organisations. However, as a softer concept, the *people* element is less tangible than its counterparts. BIM adoption requires fundamental process changes to occur in a coordinated manner across multiple, interdependent disciplines within a single project setting, outside of process and technology considerations. In other words, whilst the digital infrastructure is continuing to evolve, sector culture – i.e. the shared social behaviour of people – needs to adapt alongside it for BIM to be effectively adopted. To this end, BIM is a systemic digital innovation[24][25] which presents additional challenges to be considered.

Systemic Innovations and Assimilation Gaps

Fichman and Kemerer[26] challenged the traditional Rogers model of innovation diffusion[27] by outlining the existence of a discrepancy between the *acquisition* and *deployment* of an information systems innovation – see Figure 2. By doing so, the authors challenge our dichotomous understanding of adoption decision-making processes and caution against the risk of over-optimistic appraisals of widespread diffusion. Whilst indeed valuable in developing further insight into the behavior of simple innovations, the *assimilation gap* concept can be extended to better explain systemic innovations such as BIM.
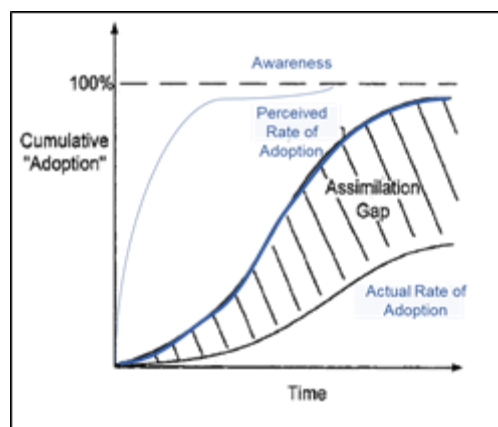
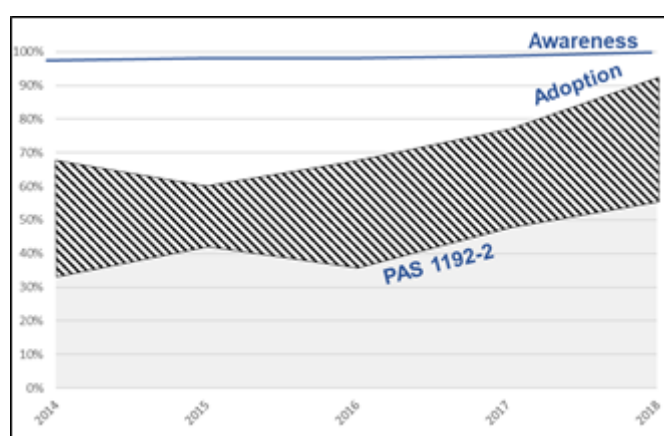*Figure 2. "Assimilation Gap" Adapted from 22.*

Figure 3. "Assimilation Gap" between adoption and   PAS 119-2 curves.

For example, the adoption of BIM in the UK is being supported by a suite of standards and documentation. If we apply these standards as proxies for a "module" of BIM, then the adoption of these will likely diffuse at different rates, depending on how novel the concept is to the decision-maker. To further elucidate the thesis presented here, the adoption rate of the PAS 1192-2 standard, as derived from the NBS publications, is plotted against the curve presented in Figure 1. PAS 1192-2 is one of the original, core standards guiding information management in a BIM environment during the delivery phase of a project[28]. However, despite its influence on the UK's BIM discourse, Figure 3 illustrates that a discrepancy does indeed exist between its adoption curve and that of BIM. More worryingly, the PAS 1192-2 standard represents the most adopted out of the entire suite, indicating larger gaps exist with the others. Furthermore, the suite of standards is currently transitioning into ISO standards which, although similar in core principles, will still require a shift in process and terminology and thus adopters will have to adapt again, threatening a further lag in whole-BIM assimilation.

Conversations surrounding digital construction have already powered ahead, with national bodies referring to new concepts, such as *digital twins*. Yet, it seems as if assimilation gaps may undermine what we have been trying to achieve for years which, in turn, may reflect the lack of similar evolution in the sector's education and training model to support this paradigm shift. Yet, the challenge of education and training within the AECO industry has never been so complex. The pressures to embrace new digital approaches are intertwined with an increasing emphasis on achieving a

sustainable built environment, with both areas demanding systemic transformations in sector culture and capability. Moreover, the knowledge framework underpinning the sector's standards and performance is generally ill-defined, with unregulated publishing processes enabled by the internet threatening to further compromise the integrity of the traditional knowledge production and dissemination model[29]. In an industry ingrained with competitiveness and increased risk of consuming misinformation, the posited assimilation gap effect may be a product of "BIM-Wash" as a ~3million-strong industry is pressured to adopt without an effective upskilling model.

METHODOLOGY

The present study aims to further investigate the assimilation gap phenomena within the context of adoption assessment metrics and current upskilling practices. The study employs focus group interviews (FGIs) as the primary data collection method. Unlike the typically used questionnaire surveys which aim to delineate our understanding of BIM adoption, FGIs enable a forum-like discussion to take place between various individuals in which they can share and clarify their views on a specific problem[30]. This allows the gaps revealed by the literature review to be validated[31].

Participants and Sampling

Professionals with diverse job-related characteristics, such as differing levels of BIM expertise, industry backgrounds, and exposure to upskilling activities, were sought to capture the underlying problem from multiple perspectives within a single forum. Although the difference in professional backgrounds could lead to conflicts in opinion and thus challenges in moderating the focus group, such observations and any emergent patterns would likely be representative of, or be of value to, the underlying key themes[32]. In addition, engaging with such a heterogeneous group was particularly suited to the exploratory nature of the present study, given the nascence of the overall research domain and the gaps presented by the literature review.

Self-selection sampling was employed, which allows for potential subjects to express interest in taking part in the research following a publicized call for help on social media platforms. This can be advantageous for exploratory research as the voluntary nature of participant recruitment tends to result in subjects coming forward who offer particularly strong opinions on the stated research topic[32].

FINDINGS AND DISCUSSION

Two FGIs were conducted virtually via the WebEx communication platform which allowed audio and visual capture for transcription purposes. To guide the FGI session, an interview schedule was prepared which set out four Themes and was sent to each participant prior to the FGI sessions. The anonymized participants and their demographics, including those related to their organization, are provided in Table 1. As demonstrated, a sufficiently heterogeneous sample was obtained. Differences were noted across the years of experience, both in industry and working with BIM, in location within the UK, organization type and size, and in the broader sector.

Code	Experience (yrs)		Location	Job Title	Organization		Sector
	Ind	BIM			Discipline	Size	
101	14	10	SC	BIM Lead	Design Consultancy	190	Industry
102	18	2	SC	Head of Future Workforce	Innovation Centre	18	Training Provider
103	13	13	EN	Digital Solutions Director	Engineering Consultancy	~ 5,000	Industry
104	10	2.5	NI	AEC Software Consultant	BIM Consultancy	35	Industry
				MSc Student	University	N/A	Education
105	7	7	EN	Digital Construction Consultant	Engineering Consultancy	10,000+	Industry
				Guest Lecturer	University	N/A	Education
206	31	20+	SC	Digital Director	BIM & Digital Information Management Consultancy	1	Industry/ Training Provider
207	20	7	EN	Head of BIM	Tier 1 Contractor	~ 20,000	Industry
				Engagement Co-Lead	Alliance (Umbrella Organization)	N/A	Policy
208	19	3	EN	Chartered Architectural Technologist	Architecture & Interior Design Practice	33	Industry
				Business Owner	Architecture Practice	1	Industry
				DEng Candidate	University	N/A	Education

Table 1. Profile of FGI Respondents

Theme 1: Macro-Level BIM Adoption Rate Assessments

The core emergent finding of Theme 1 validated the literature review's premise that present macro-level assessment tools are insufficient. Although it was noted that measurement in any form is indeed valuable, surveys such as the NBS were frequently criticized for their poor reach and representation. This was interesting as academic studies view such commercial-based surveys as advantageous for achieving large sample sizes, yet respondents felt like that sample was "*tiny*" and "*only reached 0.3% of industry*". This reflects the complexity of the task in being able to capture real-world phenomena from a large industry. Moreover, the tools were criticized for only representing the views who are already interested in the subject. Whilst this is indeed a drawback and will neglect those who are not in favor of adopting BIM, this provides value to the present study by highlighting that even those who are interested display discrepancies in their knowledge of BIM. If we can identify weaknesses within

the existing upskilling mechanisms, we can respond and adapt to support those who have not started their BIM journey yet. Therefore, measurement is important as Respondent 207 noted: "*you can't manage something unless you can measure it*".

Theme 2: Micro-Level Individual Adoption

Although not inherently reliable, the data published by the NBS may indeed reveal a pessimistic undertone in which practitioners are saying one thing yet meaning another. Respondent 206 referred to the terms "*Hollywood BIM*" and "*complete smoke and mirrors*", highlighting the tendency of industry to inflate what they are doing. Furthermore, the original concept of the assimilation gap was hinted at, in which respondents highlighted the acquisition of a Common Data Environment and yet did not use or deploy it on projects. Respondent 206 went onto say that there is "*probably only 20 or 30 people [...] in the UK that really know what they are doing and actually are doing it*", which as someone who is involved with industry daily, anecdotally confirms the paper's stance on the existence of "BIM-Wash" and its influence on an individual's perception and assimilation of BIM.

Theme 3: Macro-Level Upskilling Provision

The response to Theme 3 substantiates the claim that current upskilling provision from a macro-perspective is lax and ineffective. Respondent 103 suggested that funding is a huge issue, not just in upskilling yourself but in vendors and other bodies being able to invest in creating effective programs that suits industry's needs. It was suggested that this could be a role for the UK BIM Alliance, but as a not-for-profit body the funding issue would remain. Ultimately, the material being delivered now is at risk of disseminating misinformation which causes more damage than it fixes. Whilst certification bodies exist to provide accreditation, these are not held to any standard themselves and anyone can develop a certification process. Furthermore, most certification processes focus on the organization's ability to adhere to a single standard rather than assessing actual practice. As Respondent 101 noted: "*any organization can get accreditation but it's only a really small proportion will actually be following [the standards] on a day to day basis.*"

DISCUSSION AND CONCLUDING REMARKS

BIM is presenting a new and fascinating sector-wide paradigm shift which is not only challenging industry, but also our existing education and training model. Moreover, the introduction of BIM presents us with an opportunity to redefine our understanding of systemic innovations by moving away from a dichotomous approach to adoption and embracing the connotations of the assimilation gap. Building on this, the golden thread running through each of the identified themes is a call for a focus on the micro-level. Diffusion is driven by collective action[27] but if the individual practitioners are compromised in their own assimilation, reality will not reflect rhetoric which runs the risk of undermining the role of the UK as a policy leader in BIM.

One could argue that the sector is too heterogeneous for a "one size fits all" approach. Whilst this is true in that the exposure to the various BIM components will vary according to the individual's job role, discipline, and skill level, the present study suggests that a basic, common level of understanding will be necessitated across the industry to support a standard degree of performance and widespread adoption. This paper therefore concludes by advocating the development of a core body of knowledge which stretches across the many facets within industry. A central resource would enable standardized material, competences and knowledge to be created across various upskilling and certification bodies, thereby supporting a more effective upskilling model and the move towards closing the assimilation gaps.

Further Work

This paper forms the initial part of a wider doctoral study. Its exploratory nature situates the study as a scoping piece of work and therefore establishes the groundwork for further study. Further work will include the development of a quantitative instrument to validate and measure the findings presented here. Other suggested works include conducting case studies with ethnography to gain a richer understanding of how individuals and organizations approach the issue of upskilling.

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CREATING RAINBOWS: THE ROAD TO SUCCESS

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INTRODUCTION

Construction is one of the least diverse sectors in the UK with only 13% of employees' female, and 4% of employees BAME (compared to the national population of 12%)[1]. Yet growing research indicates that diverse workforces lead to innovation with gender diverse companies 14% more likely to perform better and ethnically diverse companies 35% more likely to perform better than non-diverse companies[2]. There is also a growing skills gap in the sector particularly with the expanding use of technology across the industry[3]. Interviews with those in construction show that family is a major influencer for those entering the industry. However, the industry cannot continue to rely on this method if it is to address the current skills shortage and attract a wider diversity of entrants.

The BRIDGE (Building Routes Into Degrees with Greater Equality) project[4], a collaboration led by Gateshead College with Northumbria University and Derby College, sought to address these challenges through positively changing young people's perceptions of the sector together with challenging the construction sector to change its culture to become a more inclusive and thus more attractive workplace. This paper focuses on the set of project interventions designed for young people to challenge their perceptions and enhance their career knowledge of the construction sector.

THE CHALLENGES

A comprehensive literature review identified six major barriers to young people in terms of progressing to further study and employment in the construction sector. These are discussed below.

Image of the Industry

The public has a long-standing, low profile and negative image of the construction sector. Typical words used by the public to describe working in the construction industry include dangerous, physically demanding, dirty, cyclical, tedious, and hazardous[5]. The public also perceive that the construction industry is less prestigious than others and is a sector where employees are uneducated, low-class, low status and non-professional[6].

Lack of career knowledge by young people and their key influencers

The career knowledge of the construction sector among students, parents and the general public is generally low. Construction is viewed as a less attractive career option compared to engineering, manufacturing and retail and is perceived by young people and their key influencers including parents

and career advisors to be about being outdoors and getting dirty and most suited to young people who do not get into college or university[7].

Gender Stereotyping

Gender stereotypes are "structured groups of beliefs concerning characteristics - traits, behaviors, attitudes, values and nouns - which are generally thought to be typical or desirable in women or men"[8]. A commonly held perception is that women are not suited to construction with two main reasons quoted for this: (1) women do not have the physical qualities needed to work on a building site such as the physical strength or confidence to work at heights; (2) women cannot endure the hard work associated with the hostile conditions of the sector. A study by Redrow found that only 29% of young women had been given advice on a career in the construction industry compared to 40% of young men[9].

Culture of the industry

Although the culture of the industry is considered a generic barrier to entry, it particularly makes women feel unwanted and not for 'people like me'. This cultural barrier is discussed in the literature with respect to the sector's masculine-centric culture, harsh working conditions, recruitment practices and sexist attitudes[10]. Bad language, sexist jokes and negative attitudes towards women are prevalent across the sector with reports of harassment, swearing and discrimination especially on site. Closely linked to this is the perception that women are not as good as men, and therefore they have to prove themselves before they can be accepted and trusted[11].

Marketing and recruitment practices

Recruitment practices including their informal nature, discriminatory selection processes and sexist attitudes can all disadvantage under-represented groups. For example, Matthewson found that gendering processes like homosociality is connected to the 'word of mouth' and 'who you know' recruitment practices commonly found throughout the sector[12]. Also, since many people tend to trust the people they know and are confident in their personal networks and women are not well represented in the construction industry, they are automatically put at a disadvantage[13].

Non-inclusive Training and education

The challenge of male-dominated advertisement and training materials has been reported as a barrier to women entry and retention in the construction sector[14]. Non-inclusive educational materials and practice can also be a barrier for BAME (Black, Asian and Minority Ethnic) students. For example, concerns have been raised about curriculum content being focused on local or national contexts and not taking a more global or multi-cultural perspective[15].

Data Analysis of the Student Population

Data on student diversity was also collected from the three institutions. For gender, this highlighted a difference between the universities and colleges. In the further education colleges where the majority of higher education programmes are part-time and focus on technically based subjects such as Building Services Engineering and Construction Site Management, female representation was as low as 4%. In the larger university setting, where the range of degree subjects is much broader ranging from architecture through to civil engineering, and the provision is mainly full time with some part-time study, the student population was more gender diverse (30% female). For ethnicity, the proportion of BAME students was lower (8 – 14%) compared to the national average of all UK students (21%). Whilst this might be expected for the two institutions in the North East of England,

where the regional BAME population is lower than the national average, similarly low levels of participation were also identified in Derby, where the local BAME population is as high as 25%. On disability, the institutional data showed that the university was similar to the national average (12%) whereas it was a much lower proportion for the colleges where courses are largely technical/practical based and are often providing progression to higher education from traditional craft occupations. On socio-economic background, the student data indicated that the programmes at both the colleges and university were effective at attracting both mature students and those from lower socio-economic areas with the university. This data highlighted the need to address the cultural and social barriers to entry to construction and built environment programmes particularly for women and those from a BAME background.

Interviews with Students and Employers

Interviews (n=36) were conducted with both employers and students linked to the construction programmes at each of the three institutions. These examined three key areas: the motivation for choosing to study/work in the construction sector; the lived experiences; and their perception of diversity within the sector. The findings supplement those from the literature and data analysis and highlight that (1) the major influence and encouragement for choosing to study or work in the construction sector comes from family and friends who already work in the industry; (2) career support and mentoring are important to support career retention and progression; (3) there is a lack of career advice and guidance concerning the construction sector; (4) the masculine culture, gender stereotyping and low percentage of women already in the sector were identified as barriers for women; (5) there were examples of sexism particularly among employers with one employer admitting they would rather recruit a man than a woman as a man would not get pregnant.

The analysis of data from these interviews reinforces the findings from the literature review confirming the importance of family influence on those choosing to study and work in the construction sector, the lack of career knowledge generally available to young people and that the main barriers to entry center on image, culture and gender stereotyping.

ADDRESSING THE CHALLENGES

The challenges identified in widening the diversity of entrants to the construction sector are complex. Previous studies show that effective interventions should take a holistic and sustained approach to target multiple stakeholders and that a Theory of Change (ToC) can be effective in providing a theoretical framework for these interventions[16]. The BRIDGE project team developed a TOC (see Figure 1). This identified the following stakeholders: young people (18 years and under); teachers and career advisors; university and college students; university and college staff (academic and professional support); employers in the construction sector. The TOC shows the planned relationship between the short-term outputs and the medium and long-term outcomes and overall vision. These short-term outputs were then used to design the activities and interventions as well as the corresponding evaluation for the stakeholders involved and were based around six themes: image, culture, influencers, recruitment, career knowledge and technology.

This paper presents the set of interventions from the BRIDGE project that were designed and developed to address the key challenges faced by young people around their perceptions and career knowledge of the construction sector.

INCREASING THE CAREER KNOWLEDGE AND PERCEPTION OF THE CONSTRUCTION INDUSTRY AMONG YOUNG PEOPLE

Background

Two main challenges identified from the literature review and interview data was the lack of career knowledge among young people and the negative image they had of the sector. To address these, the BRIDGE project team designed, developed and evaluated a series of interventions (school based events, assemblies, programmes and workshops, pop-up shops in the community, and university and college based events) all targeted at young people. With a focus on the use of digital technologies and sustainability, these highlighted the professional careers including the design, planning and engineering careers that young people often do not know about. The team ensured that a diverse set of role models were used with examples that included women and BAME professionals.

Key Interventions

These are the key interventions developed for BRIDGE which focused on young people (18 years and under).

International Women's Day

Three sets of events focused on STEM careers and study were delivered to support International Women's Day in 2017 and 2018. Targeted at girls from local primary schools aged 7 – 11 years across North East England, these included specific workshops on construction delivered by teachers, and supported by women engineers and students.

Newcastle and Derby Construction Weeks

A series of activities were designed to dispel some of the well-known myths and stereotypes about the construction industry, provide accurate career information and promote more positive perceptions of the industry and related degree subjects. They were also designed so they could be adopted across the different geographical regions of the BRIDGE project and replicated by others in the future. The first delivery was in Newcastle in November 2017, closely followed by a second delivery in Derby. The team worked closely with the local council, careers education professionals and regional construction employers, to contribute to a week of 'taster' activities that enabled young people to get first-hand experience and insight into a range of occupations and career routeways. The BRIDGE programme focussed on higher-level, professional career routes to provide a 'carousel' of interactive sessions on: Digital Design and Building Information Modelling; Meet the Professionals; and Sustainable and Smart Buildings. The team ensured that the group of professionals, academics and student ambassadors facilitating the sessions were diverse and included BAME and female role models.

Community Pop-up Shops

To access those living in 'hard to reach' communities, a number of pop-up shops were delivered. These take over an empty shop in a local community for the day, usually during the school holidays and provide a series of activities where young people and their families can 'drop in' throughout the day. The activities are designed to be inclusive, provide practical based construction activities that portray a positive image of the sector including technological innovation and environmental benefits, and greater knowledge of careers particularly professional careers. The activities are simple to do and use cheap, familiar and readily available materials. This helps parents and carers feel confident in participating with their children and makes the sector feel more accessible to them.

BIM Show Live - Inspiration Day

Aimed at children aged 11 to 14 years of age, the inspiration day was part of the wider BIM Show Live event[17]. Having identified that the high-tech, computer-based digital imaging and design elements of construction are particularly appealing to many young people and are a strong counterpoint to their initial perceptions of what work is like in the construction and built environment professions, the BRIDGE team joined forces with local firms to provide a taster of careers in digital construction.

Gateshead Career College Initiative

Gateshead College developed a GCSE level course as part of the National Career College initiative, to support progression to further/higher education in professional construction. Targeted at 14-16-year-olds from local schools with a focus on girls and BAME students, the course had input from local employers and was designed to encourage these young people to consider the range of professional roles in the build environment[18].

Developing Career Related Resources

It is essential to have suitable resources to support these interventions. The BRIDGE team partnered with WISE[19] to create a 'People Like Me' set of resources for the construction sector. Designed to get girls to think about their own personality and individual attributes, the resources introduce a range of women who work in professional construction roles and encourage girls to relate to them as 'people like me'. The BRIDGE Project also identified and used these resources: 'A Professional Career in the Built Environment' and 'Construction Mythbuster Activity'[20].

Evaluation

The project adopted a pre- and post-evaluation method to assess the short-term outputs of these activities on the young people. This evaluation focused on two key areas: image and career knowledge. These were evaluated by looking at the words young people were using to describe the industry and what jobs/careers they could tell us about. These were analyzed to determine the short-term outcomes and the potential for delivering longer-term impacts with sustained interventions over time.

Major Findings and Discussion

The major findings from the interventions with young people centred on image and career knowledge and found that young people had a more positive image of the sector, had an increased awareness of professional construction careers and a more positive experience of the sector. These key findings are now discussed in more detail.

Young people have a more positive image of the sector

Young people were asked to use five words to describe the construction industry. Before the interventions, the baseline results show that while some of the young people used words like important, growth, interesting and modern, the majority used negative words such as hard, dirty, demanding, dangerous, messy and tough. In particular, girls used the following words to describe the industry: male-dominated, tough, messy, dangerous and difficult. Young people also used stereotypical words to describe the industry including labour, hands-on, concrete, and structure.

Each young person took part in one or more of the interventions and workshops designed to showcase the positive aspects of the industry, professional careers available, and the innovation and forward-thinking aspects of the industry including the technological advancements. These interventions were

also designed to break down the barriers and stereotypes associated with the industry. Analysis of our post-evaluation data showed that young people were describing the industry with new positive words such as diverse, sustainable, secure, BIM, team, automated, digital, high-tech, interactive and well paid. Post-intervention, females used positive words such as technology, developing, creative, skill and design to describe the construction industry.

Increased awareness of professional construction-related jobs

The analysis from the evaluation data also showed that following the interventions, young people are more aware of professional construction-related jobs. The pre-evaluation baseline shows that young people mainly report construction jobs as fitters, welders, joiners and bricklayers with only 41% of the jobs identified as professional. Post intervention, the analysis shows that they are more aware of the professional jobs in the industry with 78% of the jobs they identified being professional jobs. They also reported a wider range of professional roles post-intervention, including architectural technologist, data analyst, mechanical design engineer and BIM architect. This indicates they have a more informed and positive view of careers within the industry. Furthermore, the findings show an increased aspiration towards these professional jobs. When asked if they would consider a career in the construction sector, the data from the post-evaluation show that 88% of the jobs they would consider as a future career were professional jobs. These also included a wider range of careers compared to the baseline such as mechanical design engineer, building service engineer, CAD engineer and engineering designer.

Young people having a positive experience of working in the construction industry

The analysis of the post-intervention evaluation data shows that 78% of the young people believe that "*People who work in the built environment professions can make a positive difference to the world*". Furthermore, 87% of the respondents agree that "*professionals who design, engineer and construct our buildings are helping to create a more sustainable environment*".

A detailed survey of the Career College students found that the programme was providing a rewarding real-world experience for the participants, giving them knowledge of potential careers and an insight into the technological tools commonly used in the sector. As one of the female participants commented: "*I have gained an insight into the construction world and how buildings are designed and made. I have also learnt new ICT skills and improved my presentation techniques*". Another respondent stated: "*I have learnt everything on architecture, from who runs the site to who creates everything, such as the client, the builders and the architect. I have also worked with real instruments in the industry*".

CONCLUSION

This study has found that carefully designed interventions and programmes for young people can lead to a positive change in their perception of the construction sector and can increase their knowledge of career and study opportunities available to them. It is important to ensure that these are inclusive and aimed at challenging stereotypes about the sector. Education and industry need to continue to work together to break down the barriers to entry associated with construction to create a more diverse and truly rainbow sector.

NOTES

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EXPLORING WRONG PERSPECTIVES: FUSING GEOMETRY AND EXPERIENCE

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INTRODUCTION

Our proposal should be considered as a reflective conversation between three different parties: an artist, a mathematician, and an architect – the first-person storyteller. All three of us are involved in teaching (aspects of) drawing/ visualization for architecture students and share a mutual interest in exploring the boundaries and extensions of perspective drawing.

I fondly remember Dirk's mischievous smile when he stated that he "*had found a geometrically sound method to construct 'wrong' perspectives* and by doing so he added, he could prove '*wrong' perspectives are also 'scientifically right*". Hélène - our fellow drawing instructor - immediately objected that "*geometrical constructions of wrong perspectives risk 'providing a methodology' for 'wrongness', shortcutting intuition and straightforward discovery of 'finding' an intuitive value of a 'wrong' perspectives*". Doing so, she argued, runs the risk of turning the whole idea of inventing 'wrong' perspectives into a rigid system once again. I begged to differ with Hélène - especially when conceiving forms and spaces. For me, Dirk's methodology appeared to open up a way to understand, construct and perhaps more importantly, compare different kinds of perspectives beyond convention.

To fuel our conversation, we started exchanging drawings. Dirk's series of explorations to geometrically construct '*wrong'* perspectives sparked Hélène to provide a visual critique upon a historical drawing to which I contributed a set of design-based drawings which attempt to visualize more than one can perceive.

WRONG PERSPECTIVES

When a four year old child draws something on a sheet of paper exclaiming that it is '*a mountain in the rain*', we tend to appraise the endeavor. By indulging ourselves into the unlimited playfulness of children's drawing activities, we can easily accept children's imaginative endeavours. Yet things start to shift when our child grows older, when the drawings start to be evaluated according to their ability to "*provide a visual account of the child's intention*".

Our modern western way of looking and image making is founded upon the system of 'vanishing point perspective'. The tendency to present linear perspective as a superior tool led sociologist and

philosopher Bruno Latour to reflect upon its governance. Latour draws a link between how cultures make the world visible and how they understand that world. Because in the Western World the perspective drawing proved to be such a powerful tool, it was quickly adopted into the scientific world and additionally influenced science to go into a direction that further developed technologies of optical consistency.[1]

Since Brunelleschi, Alberti and their contemporaries (re)introduced the system, we have become accustomed to evaluating expressions by means of the kind of the static imagery they put forward.[2] Moreover, people are convinced that the system is the most accurate or even 'the best' way of depicting the world around us.[3] Since its Renaissance (re)introduction, deviant ways of depiction - not fitting the scientific model - were put away as primitive or infantile, depending on the source.

In "Real Spaces" David Summers states: "*if we are accustomed to thinking of images as imitations of the appearance of things, then all images do the same thing, either well or poorly*". Summers goes on to argue that it is the historical task to distinguish the purposes of an image and their requisite conditions. In other words, we must explain both implements and images first by examining their conditions of presentation.[4]

According to psychologist James Gibson, linear perspective takes the central problem to be how one could see into the distance, while never asking how one could see into the past and the future. For Gibson, perception relates to the interaction of mind and body by stating that perception is a psychosomatic act of a living observer.[5] For Gibson it is obvious that a motionless observer can see the world from a single fixed point of observation and can thus notice the perspective of things but, he continues, it is "*not so obvious but (...) true that an observer who is moving about sees the world at no point of observation and thus, strictly speaking, cannot notice the perspective of things*". Erwin Panofsky noted a similar thing when he stated, "*The structure of an infinite, unchanging, and homogeneous space—in short, a purely mathematical space—is unlike the structure of psychophysiological space: Perception does not know the concept of infinity*."[6]

Linear perspective has been questioned ever since its alleged invention. Leonardo da Vinci, writing only a few decades after Brunelleschi's passing dismissed linear perspective as '*perspectiva accidentalis*' and drew attention to the visual distortion of the various visual manipulations and elisions that occur from moving the vanishing point in paintings and drawings.[7]

WHAT DO WE SEE AND WHAT DO WE DRAW?

*Figure HA1: when looking into space with one fixed eye,
one can only see a small part of the space in front of us*

Hélène shared a photograph to illustrate that when we look into a space with one fixed eye, we can only see a small part of the space in front of us undistorted – no more than a stretched hand (Figure HA1). Still the fixed eye is the starting point to explain how to draw perspective. For the untrained drawing scholar, Hélène argued, this can be very confusing because there is a discrepancy with what one sees and what one is challenged to draw - from (so called) observation.
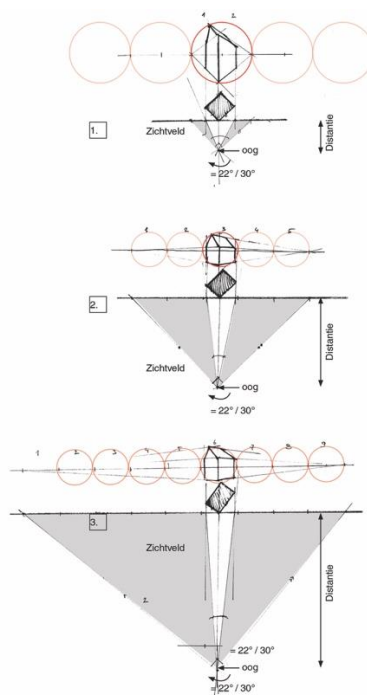

Figure HA2: The relationship between distance of the observer and the horizontal distance between the vanishing points.

We, drawing instructors, go at lengths to explain the relationship between the distance of the vanishing points and the relative position of the observer. There even exist some rules for constructing non-distorted perspectives, which is based on a maximum angle of vision of 30 degrees or even stricter, 22 degree (Figure HA2). The maximum size of the drawing itself should fit at least five or six times between the two vanishing points.

The problem with these rules of thumb is that they depart from a tightening of the focal point. For someone who unconsciously looks into the world this again is confusing, because - only freaks look into a frozen world with a stiff neck and one eye closed.
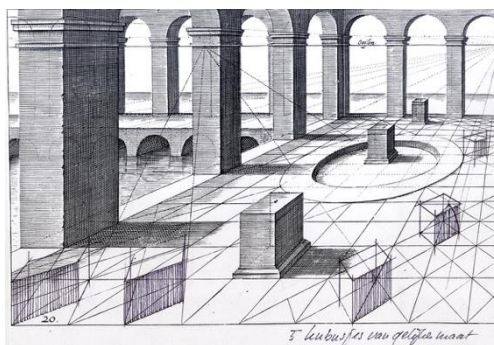
Figure HA3: Analysing a historic Hans Vredeman de Vries perspective

To illustrate her point Hélène send us an analysis of a historical Hans Vredeman de Vries perspective drawing.[8] At first glance the original looks like a meticulously constructed drawing of an architectural space. But as Hélène started adding cubes to the Vredeman de Vries construction, diagonal distortions started to surface. Close to the horizon Hélène's cubes look rather okay. But at the right side of the bottom-line Hélène's new cube doesn't confine to what we normally can see. The angle on the foreground is a 90-degree angle, which corresponds with a point of view of hanging straight on top of the cube. From this position one is not able to see the vertical planes of the cube at all. More to the left the angles of Hélène's two "cubes" even become smaller than 90 degrees, which is essentially impossible to see (Figure HA3).
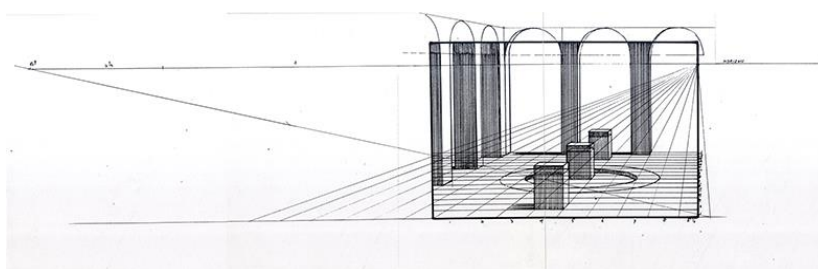

Figure HA4: Reconstructing Vredeman de Vries using the rule of thumb (first attempt)

Hélène decided to reconstruct the Vredeman de Vries drawing. The reconstruction departs from a plan analysis of the situation, redrawing the grid, using our rule of thumb concerning the relative distance between vanishing points previously mentioned in figure HA2. This resulted in a drawing which only shows the right part of the original view (Figure HA4). A second reconstruction shows the whole scene, drawn with the vanishing points 5 times between the maximum size of the image (Figure HA5). In this image you can hardly see the floor's tiles. Turning the drawing into a kind of a façade with a very little foreshortened floor in front of it.
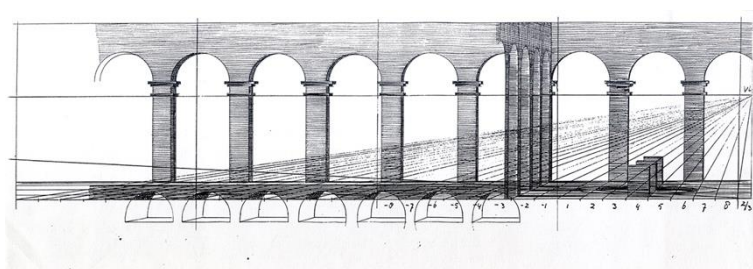

Figure HA5: Reconstructing Vredeman de Vries using the rule of thumb (second attempt)

Analyses such as Hélène's illustrate a genuine contradiction in drawings such as those of Vredeman de Vries, because in reality the human eye is not able to perceive what is depicted in these images. In that sense Vredeman de Vries' drawings are geometrically 'correct' but appear to be visually 'wrong'. Reflecting on this issue I observed that Vredeman de Vries' drawing seems to depict more than the eye can see. This reminded me of a quote from a Chinese master draughtsman: "*Why should we restrict ourselves? Why, if we have the means to depict what we know to be there, paint only what we can see from one viewpoint?*"[9]

WRONG PERSPECTIVES IN GEOMETRY

In "Perspective as a Symbolic Form" Panofsky questions linear perspective's universal validity as an accurate description of natural vision calling linear perspective '*one of those "symbolic forms"*' in which "*spiritual meaning is attached to a concrete, material sign and intrinsically given to this sign*".[10] Panofsky argues that Antique perspective is the expression of a specific and un-modern view of space and even of the world.[11] Panofsky argues that in linear perspective the psychophysical space was translated into a mathematical space and, as such objectified the subjective.[12]

From the above we could easily conclude that we should move away from geometry's systematic reading of space and return to a more discontinuous reading of space - pre-mathematical space if you will. If one agrees that geometry will always reduce the world to its measured spatial coordinates, it is easy to discard spatial geometry in favor of more experiential and intuitive frameworks of drawing and perception. To counter this conclusion Dirk sent us an analysis of a 20th century Popular Congolese painting, claiming that the laws of geometry can also be extended.[13]

African perspective, Dirk argued, can be understood as an appropriation of European and African visual systems. Compared to Alberti's "Construzione Legitima" the represented perspectives are completely 'wrong'. But the African example reminded Dirk of the constructions of the so-called Flemish Primitives and he sent us an analysis of Jan van Eyck's Dresden Triptych. In his analysis Dirk had reconstructed the perspective grid, revealing that Van Eyck's parallel sight lines do not all converge towards a central vanishing point, but on a vertical vanishing line.[14] Because the lines form a skeleton, rather than one focal point, Panofsky referred to these kinds of perspectives as 'fishbone perspectives'.
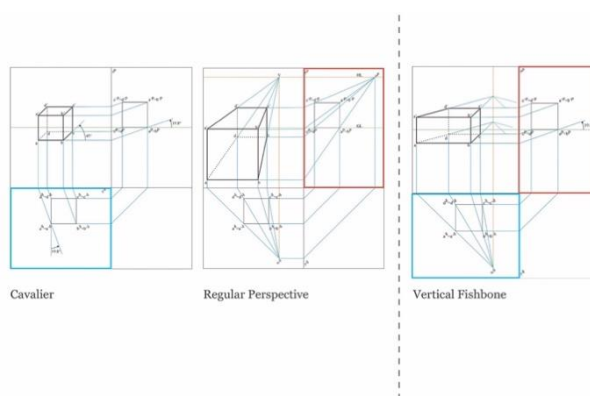
Figure DH1: Geometric construction of a Vertical Fishbone perspective

Dirk started looking for a rational method in Van Eyck's alleged symbolic 'fishbone' perspectives. In a series of constructions Dirk explored ways to project 'wrong' perspectives. In these, he reconfigures the conventional geometrical techniques as introduced by Gaspard Monge (Figure DH1).[15] To construct a vertical fishbone similar to Van Eyck's depiction, Dirk fused the top view and

construction of a cavalier projection (blue) with the side view and construction of a regular perspective construction (red) to arrive at a fishbone construction. As opposed to Panofsky's symbolic form, we now have a practical form which can be explained to other people. An interesting aspect of Dirk's approach is that we suddenly can shortcut art history and visual analysis by re-constructing different, alleged 'wrong' perspectives, geometrically.

Dirk's research resulted into an intriguing collection of geometrically re-constructed historical 'wrong' perspectives. Think of reverse horizontal fishbones and reverse vertical fishbones, and everything in-between. His explorations also challenge us to transcend their historicity. Dirk's constructions are of interest to us - designers and architects - because they imply that by fiddling with points of view, perspective systems and projections, we are able to extend or surpass the convention, while still remaining measurable. A logical next step was to explore Dirk's research in an actual design process.

WRONG PERSPECTIVES IN DESIGN PROCESSES
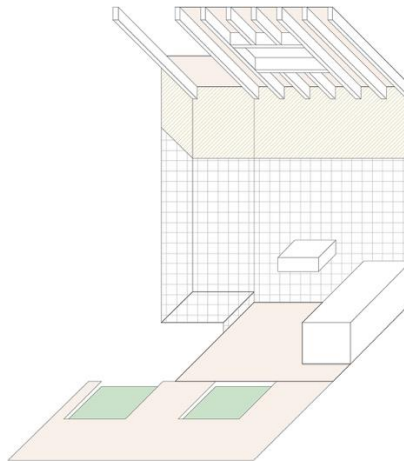
Figure RS1: Digital sketch of a bathroom lay-out combining different parallel systems

With Dirk's collection and suggestions in mind, I started rethinking the design drawings for the re-novation of a single-family house. In a first attempt (Figure RS1) I reconfigured a cabinet projection in order to make walls, floor and ceiling visible in one drawing. I turned to this 'wrong' projection with a purpose, to visualize more than convention allowed me to, while still remaining measurable. After communicating this drawing to the client and carpenter, I discovered they didn't question the appropriation of different projective systems at all.

Figure RS2: Digital drawing of electricity lay-out of a kitchen

Inspired by the previous experience I decided to communicate the kitchen's light and socket lay-out to the electrician with a similar projection (Figure RS2). The drawing uses a combination of an unfolded plan, section and cabinet projection. Architects rarely draw elevations of elect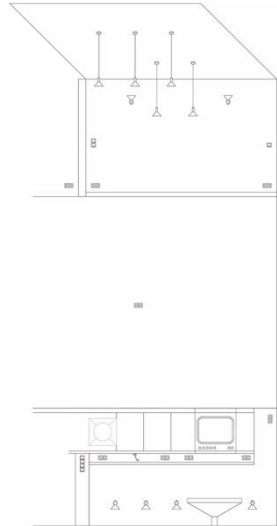ricity fittings, but in this drawing, I drew all surfaces of the space and tilted the ceiling to reduce the drawing area. This decision added a certain spatiality to the drawing. But the most important discovery of the drawing is that this awkward drawing helped us to discuss the technical particularities of the lay-out. It also surpassed a conventional electricity plan by making all surfaces available in one drawing. Both drawings revealed to be equally - or even more - communicative compared to traditional representations.
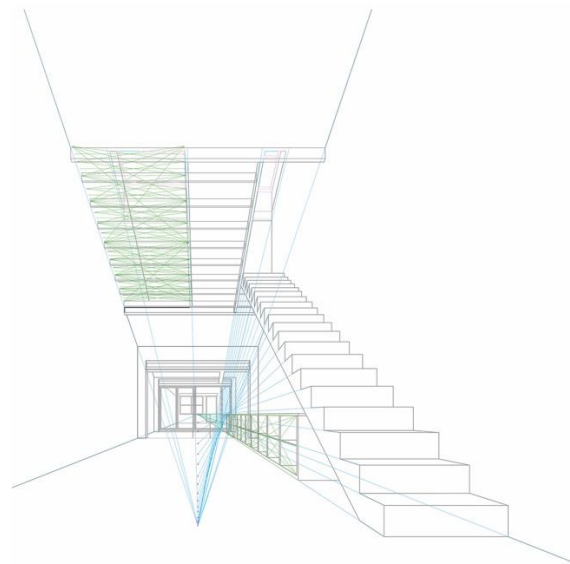

Figure RS3: Wrong Perspective of the main space of renovation project.

The previous drawings remain metrical. They are 'wrongly' according to the rules but still avoid perspective. As I wanted to explore the concept of 'wrong' perspectives I still needed to explore an instance, which required the stretching of the perspective grid. In a following drawing, I tried to

visualize the effect of having a very deep horizontal view (30 meters), and a vertical view towards the large sky (Figure RS3). Single point perspective resulted in similar visual restrictions; Hélène mentions when she reconstructed the Vredeman de Vries drawing. In line with Dirk's constructions, I started stretching the perspective on a vertical line. At first, I did not think much of the attempt, but this changed when during construction the stairs were installed, and the mezzanine was opened. When I entered the project, I looked into the distance and then upwards, which reminded me of the drawing I made. I observed, the drawing evokes a similar effect: looking horizontally and vertically by moving one's head up and down. Later I realized that the drawing's focal points are the points where the light comes into the project, leading me to suggest that the drawing evokes a natural (head) movement towards the luminous parts of a space.

DISCUSSION

As drawing teachers, we more often than not observe, that rigid conventional instruction tends to trick our learners into thinking that there is only one way of drawing (and perceiving). This kind of thinking actually limits our learners' creative and imaginative possibilities. In that sense, our research is about inclusion: uncovering multiple ways of drawing, so that our learners can investigate their own ways of imagining spatial proposals. Our role as teachers, is to explore *the how* and simultaneously illustrating where and when it can be applied during design reasoning. In other words, that ways of seeing and drawing can provide additional and valuable, spatial insights, which enhance the quality and language of spatial reasoning. Otherwise, the research is of little value to (the nascent) designers.

When we refer to 'wrong' perspectives we refer to ways of perspective drawing that consciously draw/reveal more than we can see. 'Consciously' is an important word here. If we agree that learning how to draw is a matter of 'noticing' related to observing well - architectural drawing courses should incorporate 'ways of seeing' coupled to 'ways of drawing'.

We are convinced that this kind of research also implies introducing the epistemological aspects of drawing in order to help the learners to position their quest for ways of drawing. Exploring the epistemological resides outside the scope of this paper and also implies redefining the pedagogical frameworks of our courses.

In some way or another we also have to inquire whether discarding convention is the proper point of departure for an initiation into architectural drawing. While learners have to internalize the rationality of the spaces, they imagine they also have to become aware that visualizing imagination involves more than providing an accurate account of the dimensions of a space. It is important that our students have to let go of preconceived aesthetic schemas and ideas of the correct. However, correctness is very much determined by the visual schema's we learn from others, rather than from our own observation.[16]

Perhaps scripting the mathematical foundations of Dirk's constructions can provide new points of departure for our research. Departing from the proportions of a given – or imagined space - such scripts should be able quickly to generate different series of complementary 'wrong' perspectives. The resulting variety of perspectives could allow to study their properties vis-à-vis their spatial qualities.

Finally we have to keep Hélène's preliminary remark in mind: it is important that (nascent) designers are aware of the particular expression - or experience - they want to get across and construct drawings according to their spatial needs. Otherwise, we run the risk of proposing yet another frozen system.

CONCLUSION

The 'Wrong Perspective' project is an attempt to re-approach some of the skills needed to instruct architectural drawing. In a sense our 'dialogue' fuses two opposing concepts: "Visual Geometry" and "Visual Experience". The aim is to broaden the pictorial scope of designers and architects beyond the existing ones, by testing them in design and creative processes. Consider our attempt - not as an attempt to generalize the differences, but to make them accessible and applicable in various areas.

In our research we hope to prove the value of deviating from the conventional paths of depiction, so that learners might use them in their design processes. The main idea is to figure out ways to draw more than we can see and apply these to the pedagogy of architectural visualization in design processes. When Panofsky turns to etymology to state that perspective is "*the art of seeing through*"[17] we should acknowledge that in design and creative processes perspective is the '*art of seeing forth*'!

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DEVELOPING ARCHITECTURE STUDIO CULTURE: PEER-PEER LEARNING

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INTRODUCTION

Traditionally, architecture teaching has been centered around the architectural design studio [1], where students are taught usually on an individual project basis. This studio environment is a physical space but also a pedagogical and cultural space where learning and teaching happens.[2] Students also regularly present their design and design process to tutors, external guests and peers. The studio is based on project-based learning [3] and allows for reflective practice, and integration and testing of abstract knowledge into projects.[4] This unique pedagogical tradition of studio-based teaching is based on 'reflection in action' [5], developed from the master-apprentice model, as a simulation of 'real-life' practice, with regular feedback on the student's design development by tutors.[6] However, studio culture can also lead to unhealthy practices, such as peer-peer pressure and competition, long hours, isolation from other activities, and stress when exposed to negative 'public evaluation' of one's work.[7] Nevertheless, studio culture can also support reciprocal peer-peer learning, which happens in formalized group work but also informally in the absence of tutors.[8] Advantages include co-experimenting, and learning competencies, design processes and critical reflection from and with one another [9], building a student's confidence to try new things.[10]

Through four case studies, this paper illustrates ways to enhance the unique and positive aspects of studio culture, by fostering peer-peer learning to underpin and support deeper learning and healthier practices across years. Findings and reflections on each case are jointly discussed in concluding remarks at the end of the paper.

BACKGROUND

Design studio, has the ability to be a collaborative environment which harnesses peer interaction, communication and sharing both with peers but also instructors; they learn to work with others, critically reflect and question, and to articulate and communicate ideas. This is crucial to be prepared for the highly collaborative nature of the architectural practice students will eventually enter [11]. Additionally, the studio's collaborative culture stimulates learning, socialization and critical dialogue, corresponding with Bruffee's notion of 'constructive conversation'.[12] Students gain multiple perspectives, frequently conflicting, from both informal dialogues with peers and formalized learnings.[13] Formalizing some peer-peer learning is not about teacher control, but to use the benefit of

peer-peer learning for all. The idea is that students learn by explaining their ideas to others, and by giving and receiving feedback, beneficial for all– i.e. mutual or interdependent learning. [14]

In the architectural design studio, peer-peer learning might be particularly beneficial where each student can learn *from* others but also *with* others. For example, there is a paradox in learning to design, in that students cannot understand what designing means, and can only learn this through the actual experience of designing.[15] While tutors have a guiding role, students have to self-educate, self-appropriate, self-discover and question and put their trust in their tutors, so that "being willing to try something is a condition for acquiring an ability to do it" [16], but can also be the cause of great vulnerability and anxiety. [17] This is where peer learning can support a student's journey, individually and collectively, by creating a safe environment to learn together, reflect together and, to coach, and articulate ideas to promote self-discovery (and encourage others to do the same).

Educational context

The influences of peer-peer learning are especially relevant within the context of this paper as the teaching environment is solely design studio based. Aarhus School of Architecture (AAA) is one of two independent arts-based architecture schools in Denmark. The schools' practices are firmly based in the Beaux-Arts traditions. Architectural education is offered mostly through studio-based learning environments from Bachelors to Masters level, where studio projects are 100% of the semester grade. Students are divided into three groups, 1st year; 2nd and 3rd year combined, and 4th and 5th year combined. AAA studio environments are also unique in that the education consists of diverse configurations usually, around 40 students in the Bachelors and 12-35 students in the Masters. Within the Bachelors the same (roughly) 40 students stay in the same (themed) studio for 2nd and 3rd year. They may change for Masters but then again remain in the same studio group for 4th & 5th year.

Additionally, students usually sit in table groups of four, often informally working together and are expected to be in the studio space from 9:00 am to 5:00 pm, Monday to Friday. As a result, students become very close during their education and the physical, pedagogical and cultural space where learning and teaching happens becomes very influential. The studio often becomes a 'second home' as all 600 students have their own desks all year round. What often looks like a mess to any teacher also represents a safe zone for the student. Though between peers, the studio also becomes a place of exposing vulnerability.

Figure 1. and 2 illustrate typical AAA studio working spaces, and how students make it their own.

METHODS

Four development projects and learning experiments were developed during 2018 and at different levels of architectural education at the AAA in Denmark. The first case study took place in 1st-year, while two case studies took place in the Masters program. Common for these three case studies, was diagnosing a problem in design studio and planning mutual or interdependent peer-peer focused teaching activities. The fourth and final case study, in particular, used 'vertical' peer-peer learning with around 95 2nd to 5th-year architecture student. In this case, experienced students mentored more junior peers (i.e. the traditional proctor model)[18]. However, in most cases, both mutual and proctor peer-peer learning occurred due to same-year students working together, as well as with those in 1 year above (or more years their senior, as described in case 4).

We worked semi-collaboratively by reviewing each other's teaching activities; some of us observed each other's experiments or contributed to the delivery. We discussed and reflected on shared experiences and themes, all with a common focus on how to best facilitate student dialogue. In particular, we were interested in investigating deeper learning from, and with peers, to underpin and support tutor-student learning activities in the studio.

FOUR CASE STUDIES

Case Study 1: Year 1 Design Studio

"Critiques" or "pinup" situations are part of our institutional evaluation and assessment culture, and peers are always invited to attend the sessions and to join discussions, which can take place over 2 or 3 full days. These events have substantial learning-potentials for the person presenting, but also for attending peers to reflect on their own learning, design process and project. However, participating students seem to have a hard time engaging and focusing in these more passive learning situations. Hence, this case study set out to investigate how to enhance the format to ensure engagement of the attending students, and to ensure that the time spent supports the overall course learning outcomes. The planned learning activity built on both informational, practical and emotional support between peers; the main considerations were as follows:

1.   Giving all peers a prior described role;
2.   Making slightly strict "rules" for the sessions and formalizing peer feedback after every presentation;
3.   Using a very limited time frame;
4.   Using the room as a didactic tool by "precoding" it in advance.19 For example, in this case, the room was prepared with two-sided pinup areas to allow swift changeover, and with four chairs in each area with post-notes and a pen.

Halfway through a two-week assignment in the spring semester, which is a typical time for formative feedback, four students were asked to join, pinning up their material. In advance, the tutor had defined the one-hour learning activity; the rather strict "rules" were written on a whiteboard before students entered the room, and were defined as follows:

•   Student 1 presents (5 minutes); no questions or interruptions
•   Students 2, 3, 4 and teacher reflect on material/presentation and prepare comments (2 minutes)
•   Student 2 gives feedback to student 1 - No answers (2 minutes)
•   Student 3 gives feedback to student 1 - No answers (2 minutes)
•   Student 4 gives feedback to student 1 - No answers (2 minutes)
•   Teacher gives feedback to student 1 - No answers (2 minutes)

After this Students 2 presents etc.

Reflections and findings

Observing the engagement of the students, it became clear that defining the expectation of peer-feedback made all students participate equally, unlike in the traditional pinup sessions. All four students described it as useful to have defined roles, and that it made them feel safe to comment on each other's work. Moreover, students felt that it was an interesting challenge to let the material stand-alone and not being able to respond to their peer's comments after the student feedback.

Case Study 2: Masters Heritage Design Studio

In the heritage design studio, the semester starts with group work, including a detailed building survey and the compilation of a building report. From this, students then develop individual projects; in addition to a few studio presentations (i.e. pinups), each student meets with a tutor once weekly to discuss their process and progress. All the students work with the same building, hence they share knowledge and experiences, but it also means that the design tutor ends up repeating certain information in individual tutorials. As such, peer-peer learning activities that were integrated with the

individual design phase, were developed to enhance learning outcomes, effective teaching and to support students.

Specifically, group teaching was introduced alongside individual tutorials to go in-depth with relevant themes. Moreover, students prepared and formulated constructive feedback for each other's projects (i.e. apply, analyze, evaluate (Blooms's taxonomy of higher learning levels [20])); this allowed students to learn from each other's' challenges and approaches. The peer-learning and feedback activity is unfolded below:

1. Each student identifies an issue in their project, on which they want to have feedback.
2. Two students are appointed peers on each project and have two full days of preparation.
3. Teacher and students gather around a table.
4. Student 1 presents their issue within five minutes; drawings and models are in the middle of the table, where each participant can see and discuss them. Peer 1 and 2 comment. The student listens to peer feedback, while a fellow student takes notes (active listening).
5. Then, the teacher and the rest of the students join the discourse.
6. Themes and issues relevant to the broader group are raised to meta-level instructions by the teacher.
7. Wrap up, including individual instructions for the next meeting.

Reflections and findings

Based on the above teaching and learning activity, it was clear that small-class teaching with peer-peer feedback clearly supported deeper learning and more effective teaching. Themes relevant to others in the group only needed to be discussed once on a meta-level compared to individual tutorials. Students were active and engaged; it enhanced and helped develop a supportive studio culture with positive student feedback. They also felt it was a more relaxed atmosphere compared to pinups. Students found it rewarding to focus on specific issues and to receive sufficient preparation time (for both sides).

Case Study 3: Masters Sustainability Design Studio

Both in architecture school, and in practice, the aesthetic of sustainable buildings are often aesthetically 'deterministic': i.e. their architectural language results in a 'collage' of technological solutions, in a drive to meet energy or sustainability targets. This case study investigated how to overcome this by embedding sustainable design and energy literacy teaching in design studio, an integration which is typically lacking – as also noted elsewhere.[21] Twelve masters level students across year 4 and 5, studied and critically applied the integration of renewable solar energy technologies and the aesthetic implications for their design projects. Sustainability knowledge was brought into their everyday design studio space [22], where students co-experimented and critically reflected on the implications of the new knowledge for other's and their own design projects, including architectural aesthetics.

Focusing on the reciprocal peer-peer learning aspects, specific studio-based learning activities were developed [23]; this involved a case study analysis with subsequent informal group presentations by self-selected student pairs, followed by group discussion. Afterwards, students together learned to estimate the energy use and carbon footprint of a case study building, and to evaluate its suitability for solar technology. They then applied this knowledge to their own individual design projects, supported by wider group discussions of the aesthetic and architectural implications of solar technology use.

Reflections and findings

In addition to expanding knowledge about energy technologies through "background learning," students benefited greatly from teaming up and wider peer discussion to help them immerse and test their critical position in a safe environment. The paired study and informal presentations especially seemed to help initiate the more junior students, building their confidence through critical reflection and articulation of their position. There were other benefits to peer-peer learning too; for example, some students miscalculated some energy numbers in the common workshop, but they checked and helped each other. Another example is when a more senior student transferred the workshop exercise into a spreadsheet and then shared it with everyone, helping the group to move forward collectively. Equally, during the discussion about the aesthetic and architectural implications of solar technologies, some students gently disagreed with other students' evaluations. Yet all parties were able to listen and reflect on their position in a safe environment, understanding that there might not be a "right" or "wrong" answer in qualitative assessments of buildings.

Case Study 4: Vertical peer-peer learning

The fourth case study in particular used 'vertical' peer-peer learning, where around 95 2nd to 5th-year architecture students worked together in a 2-week introductory workshop. The peer-peer learning centered around more experienced students mentoring more junior peers, and to encourage project work outside tutoring presence and formally scheduled workshop events. Teachers from two bachelor units and one masters studio came together to conduct a workshop with all of the students. The large group was divided into three teams consisting of seven smaller groups each. Each group was assigned a leader from the Masters programme to help facilitate, share knowledge and integrate deeper learning about sustainability. The peer learning within this workshop aimed to establish a culture of reflective practice across teaching programme as well as creating a sharing and non-competitive atmosphere.

This workshop involved three developing tasks which included different levels and methods of peer learning, and ranged from more formal exercises to informal group work and discussions. The more formal exercises initiated the workshop to help introduce the process, and this included group work; group and team discussions to complete a provided matrix with information, and a larger group presentations. Following this, students had input from different recorded lectures, which they then had to discuss and share with their group and then larger team to create and complete one larger exercise together. Lastly, analytical drawing exercises were undertaken; while this task was more individual, knowledge needed to be shared between groups to understand each of the drawings, with students learning by explaining, and giving and receiving feedback [24]; this was facilitated by the 5th year student team leader.

Reflections and findings

In addition to upskilling and gaining knowledge about sustainable architecture, students were introduced to different peers and teachers, helping to bridge the connection to each other and different teaching years. Setting peer-peer tasks facilitated how the students worked together but subsequently also meant that all students gained a larger amount of knowledge, gaining insights form the entire group and team, learning through discussions and presentations as well as the direct vertical learning which occurred within each of the individual groups in informal ways. Peer-peer learning was beneficial, as students learned from others in similar positions to themselves [25], however, an improvement could be placing greater emphasis on expectations of tutor and student roles (especially Masters students), and clarifying the benefits of peer-learning to the individual and the collective group.

REFLECTIONS AND CONCLUDING REMARKS

The four cases highlighted that the studio-based peer-peer teaching and learning activities supported certain learning outcomes such as working with others, critical reflection and enquiry, communication and articulation of knowledge and ideas, and how to learn (individually and collectively). It also helped students to "think like an architect" (i.e. making connections between general knowledge and problem-based scenarios), and with 'reflection in action'[26] The role of students was critical, and perhaps more important than that of the tutor[27]: peer-learning elevates the group's role and responsibility, yet allows flexibility for each individual to contribute equally. However, the session must be clearly framed and structured, so that students are aware of their role (expectations) and can engage actively.

In all cases, the importance of the design tutor's facilitating and 'coaching' role [28] was emphasized: i.e. to guide, demonstrate, and question. While the structuring of peer learning activities is important, it is crucial to allow room to practice 'knowing in action' [29], by moving into the centre of the learning to flexibly respond to the situation and interactions (e.g. to contract or expand activities or students' roles and participation, or recognize deeper learning opportunities). Importantly, the teacher needs to balance an appreciation of student engagement and inputs, while qualifying and validating the group discussion content. Therefore, space is needed for active questioning, listening and responding at meta-level [30] and for differentiated teaching and guidance (i.e. challenging/encouraging/guiding the individual student, while in the group). This might mean assigning an asymmetric role to the tutor in some activities to allow teachers to transverse learning-points.

While some refinements can be made, the four cases illustrated that peer-peer learning activities could positively support more traditional architectural teaching methods. Despite peer-learning culture being supported by the design studio's unique nature, moving the studio from individual tutor-student format to a hybrid approach with formalized peer-learning, requires a culture change. Embedding a more collaborative studio culture throughout architectural education might be achieved by introducing peer learning activities in the early stages of architecture education. Clearly, elevating active peer-participation and dialogue is in support of co-operative life-skills highly valued in architecture practice, and in society generally.

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DEVELOPING FUTURE WORKFORCES IN HISTORIC URBAN CONTEXT: A CASE STUDY OF CHAREONKRUNG CREATIVE DISTRICT IN HISTORIC AREA OF BANGKOK

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INTRODUCTION

The Landscapes of Workforces Development in Thailand 4.0

This paper is a critical examination of the compatibility of workforce development policy and the implementations in context. It derives from a study of urban area along Chareonkrung Road (/cha-roen-krung/) and Chao Phraya River in old city of Bangkok. Recently, Chareonkrung Creative District was designated as an impetus to Thailand new politico-economic policy. Thailand 4.0 is the government policy to transform the existing economy into the fast-growing platform of smart industry. A key agent is '*Thailand Creative and Design Center*' (TCDC), with missions to support start-ups and current businesses to migrate to creative-digital-economy. The prime objective of TCDC seemed to be to enhance the design thinking and knowledge for Thai business through the various kind process of learning from the seminar, Conference, Exhibition Etc.

TCDC presents clearly the vision to focus on the business and creative people. Both groups are well-educated and in upper-middle class. Even the TCDC has become the answer to needs of future learning and to enhance skill for Thai people but there is still problem to its policy implementations. The target group of TCDC include only specific group of people that is 'Creative class', the training program did not seem to serve the need of major workforces in Thai economy that is working class. Thailand business and industry foundation still relies on workforce who come from the lower and middle class of the society.

Currently every corner of this world, the spreading of automation machine and artificial intelligent is evident. Despite technology effect the 4.8% growth in GDP in the first quarter[1], but most of the resources flew into upper class economic tycoons. This gives benefit to advanced skilled workers and creative class people unlike Low skill worker class which technology will force people out of their work. According to research of Mckindsey[2] around 375 million workers will be replace by Technology replacement.

From above reason, it's pretty clear that Technology has widened gaps between the rich and the poor. If the lower workforces were continued to leave behind in the era of workforce replacement (by

automation system), it would cause great socio-economic problem in the future economic stagnant; and social depression. This situation already starts to show in a number of Thai unemployed were increased to half a million people. In 2016 and 2017, university graduates who were jobless were 103,000 and 160,000 respectively[3].

Even though the smart technology may replace many human jobs, but it will also create new jobs in the future. The possibilities may be blurred in the eye of Thai hard labor and small business owners because they could still function well in a low-tech business and industrial environment. The low and mid-skilled working classes that could adapt and learn new skills can be migrate into market demands[4].

The Creative District of Thailand 4.0: Chareonkrung Road Area

Thailand Creative Design Center (TCDC) was a good example of Thai government strategic attempt to tackle with the changing of Work landscape. In 2017, it was to promote the idea of creative economy to investors, working people in Thai society. Bangkok, capital of Thailand, has crossed thresholds of transformations which resulted from sociopolitical impetus as well as availability of new technology. Buildings from early period of the capital are evident of the urban fabric's transformation.

In the beginning of Rattanakosin period, the early days of Bangkok as the capital, Bangkokian's lifestyle was closely relate with the river. People lived, travelled, prayed with networks of canals and main river - the Chao Phraya. At night, houses were lighted dimly by gas lamps. As many other agricultural societies, public activities were lesser after the sunset.

An important transformation of Bangkok started during the period of King Rama IV. The New Road gave impetus to Bangkok Expansion in 19th Century AD. It turned the city of canals into the city of road culture. The records said that King Rama IV decided to build a first standard road in 1861AD. The road cost approximately 19,700 Bath (around 12 million Baht in 2018). The first road was so-called "New Road". King Rama IV assigned the road a formal name "*Charoenkrung*", literally means, *Rising City*. With the vision of King Rama IV, Charoenkrung Road was a very wide road for horse carriages and pedestrian at the time. Electricity reached Bangkok and Charoen Krung road. It was for the first time Bangkokian experienced life at night time. This project opened new approach to urban development in Thailand. More roads were built. During the reign of King Rama V, both government and private sector collaborate together to create road for the benefit of transportation and commercial for 110 road lines.

Figure 9 Chareonkrung Road 2404 B.E.[5]

The Bowring Treaty allowed the people to enter laisse-fairs economy. Trades and transactions were able to expand in Bangkok. Docks and warehouses, along the Chao Phra Ya River, distributed goods to retail shops on Chareonkrung Rd. It could be said that modern commercial activities in liberal consumerism, in Bangkok started along the New Road. Charoenkrung road took Bangkok across threshold to the modern world of 20th Century.

Today, Charoenkrung area is merely reminiscence of the glory past. Many buildings give sense of nostalgia to visitors – Thais and foreigners. There are traditional recipes in the local restaurants, local retail and wholesale shops of almost obsolete business. According to demographic statistic of the District, the numbers of local people in has constantly been on decline since 1990s. In 1995, the population were 70,000 approximately, and declining. In 2005, there is a sharp drop of population to 50,000 people. Since the population of Bangrak district (Charoenkrung area) were at 48000-50000 people.[67] These are evident of Bangkok urban transformation. Currently, business district has expanded and emerge around the capital. Charoenkrung area changed its role from central to peripheral area of business district.

Education for Workforces in the Era of Creative Economy

It is critical to retrain, develop and re-educate 'all classes of the workforces for up-to-date competency. Inequality in socioeconomic classes in a society will cause economy stagnant. According to Richard Florida[8], the creative class is the main factor that drives the culture and economic of the city forwards. however, many big cities which involve with creative economy, they also experienced the worst social and economic inequality. Followed by a new research of Florida., R. "*The New Urban Crisis: How Our Cities Are Increasing Inequality, Deepening Segregation, and Failing the Middle Class-and What We Can Do About It*". He put emphasis on problem related to inequality in working class in well-developed urban area. Moreover, other study (Donegan, Mary, and Nichola Lowe, 2008) has mentioned other factor which cause inequality in future. These factors can be divided into three main categories according to American cities: first, *the institutional factors*, such as declining union and a low real minimum wage. The second contains *factors that influence the earnings* of skilled workers, including the supply of college-educated adults and increased demand due to skill-biased technical change. The third contains factors that influence *the earnings capacity of less skilled workers*, such as the increased supply of immigrant labor." The second factor hints solutions within the problem.[9]

The TCDC can answer to the need of the new skill for the Thai people but the target of TCDC curriculum was a small group of people that is creative white collar. On the other hand, large number of lower-skilled workforces and people which was apparently the majority of Chareonkrung's economy, were omitted from the picture.

Even the government, Bangkok Metropolitan Administration, has long been providing training centers for skilled workers, low skilled labors. In Charoenkrung district, the retraining center is at Worajanyawaas Temple that provided training program such as Haircut, Mechanic, Thai massage, Cooking, Fruit Craving skills Etc.[10] All programs are free but most of them are mostly out of date and unable to create effective skill for workforce in future. Comparing between Bangkok training center and Singapore Lifelong Institute program[11] can clearly see the out-of-date learning program between Thailand and Singapore

Retraining Center Teaching Skill From	Future Training Skill Category From
Wat Worajanyawaas	**Skill Future Singapore (SSG)**
Haircut	Bussiness management
Salon	Early Childhood care & Education
Mechanic Skill	Employability Skill
Craft Art	Executive Development & Growth for excellence
Flower Decoration	Food & Beverage
Computer Fixer	Generic menufacturing skills
Thai massage	Human Resource management
Tailor Skill	Information & Communication Technology / NICF
Fruit Craft	Leadership & People management
Bakery	Others
Thai Musical instrument	Retail
	Security
	Service Excellence
	Tourism
	Workplace literacy& Numeracy
	Workplace Skills programme

Table 2 Study program comparison

Moreover, based on the statistic from Bangrak District Council, adult workforces of 139,521 people in Charoenkrung Area are 2 main groups: External Working Force: office worker 75% and Internal Working Force: Local business, Street food, Street Vendor 25%. A survey of the local people viewpoints on future work and retraining new skills, was carried out which include local habitat and local business in the area. Over 50% of the local people do not aware of the TCDC and creative district policy. More than 80% never visited the TCDC and Creative district (even though they lived in the heart of the district).

This have clearly revealed that the project does not concern anything with the local context and surrounding. This raised a question whether the project would have been another i) gentrification of inner-city area ii) government failed implementations of policy or iii) beginning of socio-economic disintegrations in the future. These several evidents has shown that Bangkok require a reasonable training center and learning curriculum which be able to respond to need of working class.

ANALYZING THE CONTEXT OF WORKFORCE EDUCATION: THE CITY OF THE 20TH CENTURY

The Notion of 'Culture of Congestion'

The framework of this study derives from Delirious New York – a book by Koolhaas., R. (1978) whose argument is that "The culture of congestion is the culture of the 20th century." Rem Koolhaas

(1978) states that "Manhattan - Koolhaas writes - represents the apotheosis of the ideal of density per se, both of population and of infrastructures; its architecture promotes a state of congestion on all possible levels, and exploits this congestion to inspire and support particular forms of social intercourse that together form a unique culture of congestion." 'Life in the metropolis' (Koolhaas., R. p.319)[12] These four driving factors raise 4 questions for a study of Chareonkrung district includes *1) new innovation that will drive change: 2) Mode of transportation that connect the area with others: 3) Attracting node that bring visitors and 4) Local activity that create concentration of high density of population*. The cities of the 20th Century are a result of the driving forces that led to the modern condition of living. With this framework, it means the shifts of urban structure from 19th to 20th C. were driven by:

Economic Platform: The industrial revolution, the mass production system that created job and attract people to the city
Innovations: The development of technology: Elevator, factory, transportation, and communication
Implications on ways of living: The revolution idea of vertical living: the invention of lift that allow people to transport in a very high vertical scale. It allows the tower blocks that can stack more floors of residential area on to a strict land than any other periods in the past
These three forces are common to the expansions of many cities in the 20th Century including Chareonkrung town. Charoenkrung townscape transformed into 3 different phases of time which Starting from a new road. Consequently, the expansion of Bangkok in eastern area. Thirdly, current massive change in Charoenkrung district.

Analysis of Existing Context: Architecture in Chaotic Urban Context

Mode of transportation: Metro Rails and Chao Phaya river as Transportation Network
The introduction of mass transportation BTS (Bangkok mass transit system) has a lot of impact to all type of user of this area. In the other hand the urban structure plan of Bangkok design differently. The city itself plan in the organic shape and the reason of limitation of area cause the expansion of this business and commercial area have to be moved into another district that is close by like Silom.

Attracting node that bring visitors: Old house, Old ways of living, old people
Chareokrung was left with retails shop and traditional cuisines. The business that still can survive and serve high market demand is good food. The area serve need for the tower of Capitalism.

New Innovation and Opportunity: Creative District, TCDC and Vacant Buildings
Creative district and the TCDC is similar to the idea of Coney Island and the amusement parks that represents the innovative technology, introduced into the daily life of Manhattan people i.e. staple horse. This situation also happens in Charoenkrung district. The area still play important role in itself even the city landscape is changed.

Education for lower income workforce in the era of Creative Economy
Design of professional development curriculum should consider not only the learners and the future competency. People work in 'place' and places have history, characteristics, capacity to adopt innovation is their own ways. Florida suggests that each period is move by notice of creativity and a real source of economic wealth. Florida describes this growth of creativity business in urban area which linking with history, innovation, and creation of technology. Creativity has become a new

economy for the 21st century. The context of curriculum for Charoenkrung Creative District involves with the Old chef, Old houses and modern hub of transportation network.
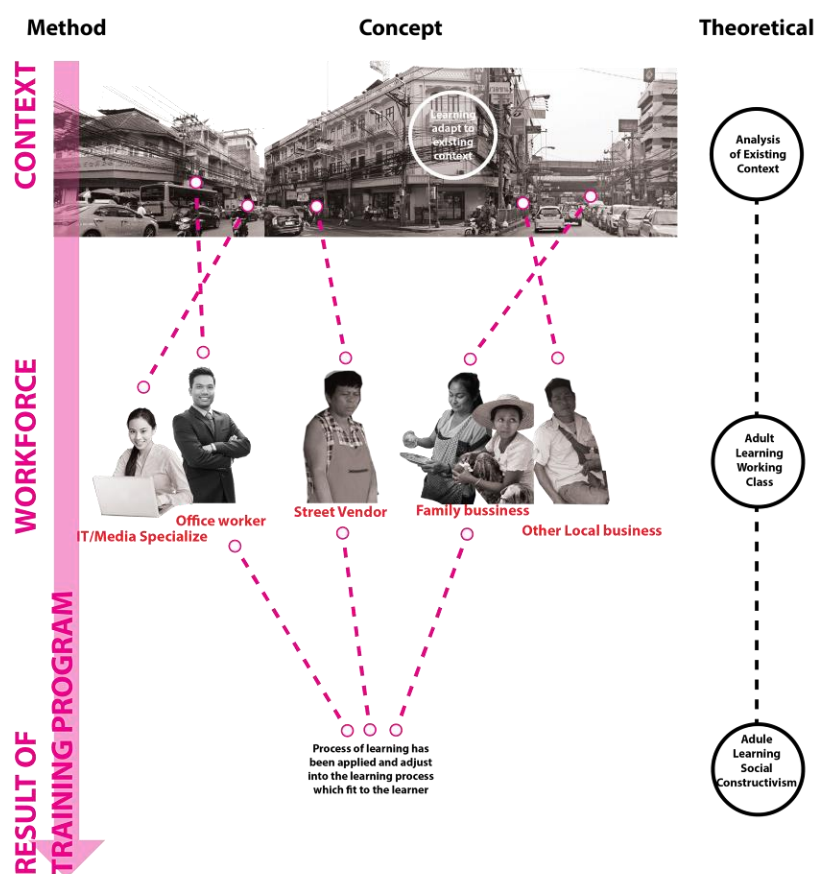

Figure 10 Analysis Training program diagram

Method	Concept	Theoretical
3.1.1. Context	Learning adapt to existing context	Analysis of Existing Context
3.1.2. Workforce	Local Business People -Family business -Street Food -Street Vendor -Office Worker -manager -IT/Media specialist -Marketing	Adult learning Working class
Result		
3.1.3. Result of Training Program	Process of learning has been applied and adjust into the learning process which fit to the learner.	Adult Learning Social Constructivism

Table 3 Comparison table an analysis to create a Training program

Reinvent New Learning Curriculum

Research of a New Learning curriculum foundation based on three ideas to create a new result. 21st century skill, Thailand Future industry, Local business and local context.
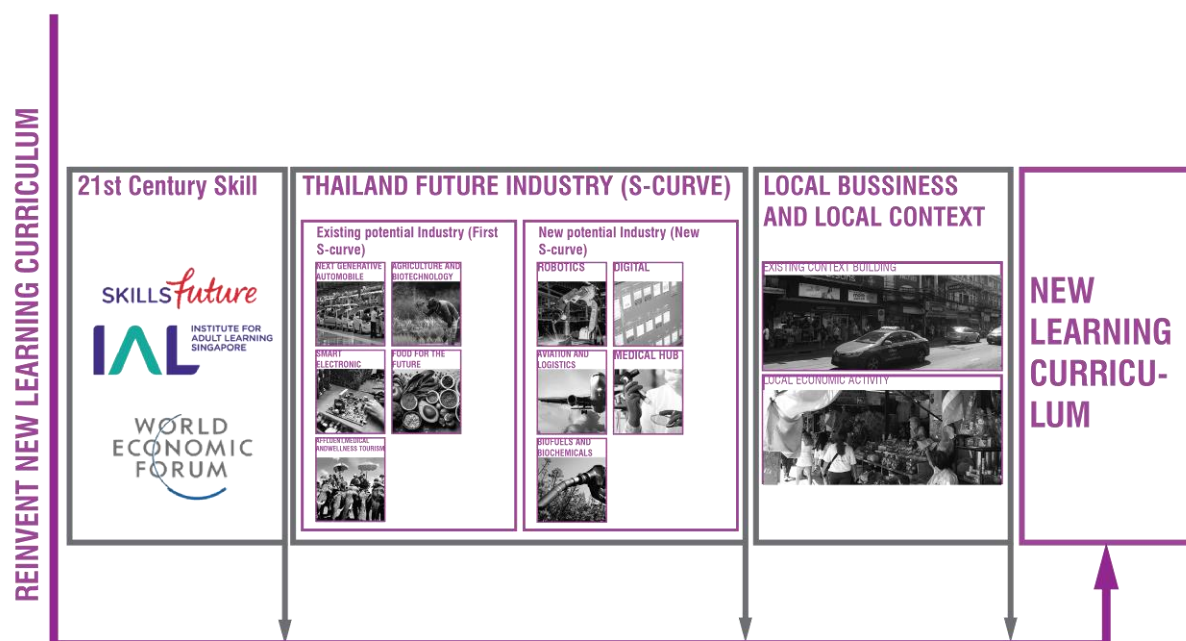
Figure 11 New Curriculum diagram

21st century Skill

All the skill has been research through institution and academy which already provide future learning skill in different country such as learning institution[1314] from Singapore people. Combine with an analysis of important skills in 21st century from World Economic forum.[15]

Thailand Future industry

Thailand future industry or S-Curve.[16] [17] will play an important role in future Thai economy divided future industry into 2 type categories. First Existing Potential Industry (first S-Curve) Next generative Automobile, Agriculture and Biotechnology, Smart Electronic, Food for the Future, Affluence Medical and Wellness Tourism. Second, New Potential Industry (New S-Curve) Robotics, Digital, Aviation and Logistics, Medical Hub, Biofuels and Biochemical

Local business and Local Context

The analysis of local character has been done through users in the area which can be divide into 2 groups (Office workers and Local businesses worker). Both groups are studied through Age, salary, education level and activity.

Learning Program related to local culture of Charoenkrung district

The strategy needs to teach local people and community to adapt with a new technology in 21st century which require people to re-skill and re-learn to follow up with technology in the new era. However, according to Thailand Creative Design Center,[18] Creative Economy require interdisciplinary between different knowledge and background to create an innovation and development, while local character and culture is one of the most important things that reflect personal character because of this local character and culture in Charoenkrung could enhance creative economy in the country to standout from other nations. Then the result of curriculum has become the answer for working class to adapt with future.

Result of Learning Curriculum for Charoenkrung District
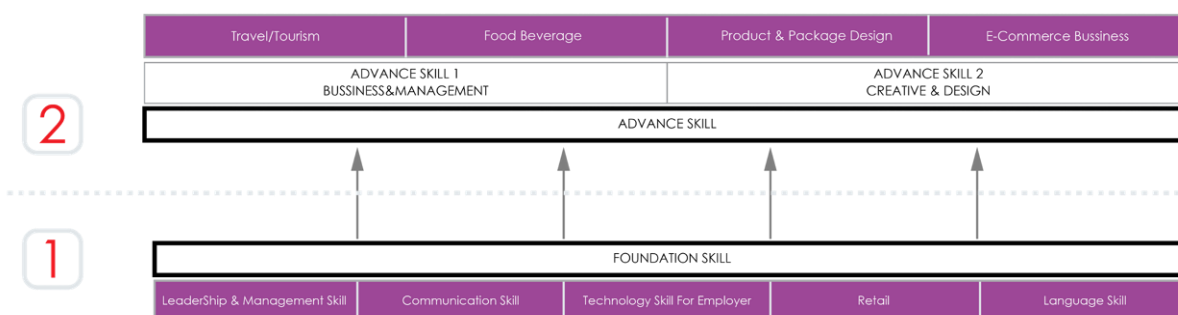
Figure 12 Learning curriculum

The following curriculum are designed to follow the analysis of context and user of the area.

1.   Foundation Skill group

The foundation skill group provide the skill that will be require for the further training for a more advance skill in the future. The foundation skills are Leadership & management skill, Communication Skill, Technology Skill for employer, Retail Skill, Language Skill.

2.   Advance Skill group

Advance Skill level continue from the Foundation Skill. The group can be divided into 2 different groups of Skill Advance skill 1 Business &Management and Advance Skill 2 Creative& Design

NEW LEARNING PROCESS: LEARNING BY DOING

Learning program follow through social constructivism method which allow student to learn from social interaction activity which could give benefit from cross disciplinary and collaboration to the learner which help to enhance student skill for future[19]. This active learning can be described as first-hand experience which has a similarity to vocational school that allow student to have both performance and academic approach better than common academic school type[20]. Learning process can be divided into 2 different type according to groups of users.

Office worker Learning Process and learning Loop

Office worker be able to learn everywhere from Cloud source and online data. After that they will learning through firsthand experience in startup business that operate under expert control and receive feedback from client and consultant. Lastly learning program allow each student has their own individual time to discuss with their advisor.
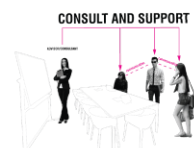
LEARNING PROCESS
Office Worker

1. Learning Process
student can learn every where, any place. Support the idea of clound technology and digital data

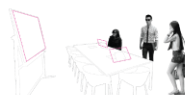**LEARNING THROUGH WORKING**

2. Learning Through working
student apply the lecture and idea of learning through they first hand experience.

CONSULT AND SUPPORT

3. Revise/ Feedback
student have watch they feed back through the clients feedback and they individual advise from consultant

REVISE/FEEDBACK

4. Consult/ Support
Students have time for their individual consult with their advisor about their bussines and future plan.

1 LEARNING
Learning in the class for some of the lecture and seminar during weekend

2 APPLY LEARNING TO WORK AS A GROUP
Apply learning to Start up bussiness as a group of student that interest with the same idea.

Communication

3 REVISE/FEEDBACK
the whole group come together to communicate exchange idea and discuss with each other.

4 CONSULT
Student be able to consult as a group or private with the professional about their start up and the future development
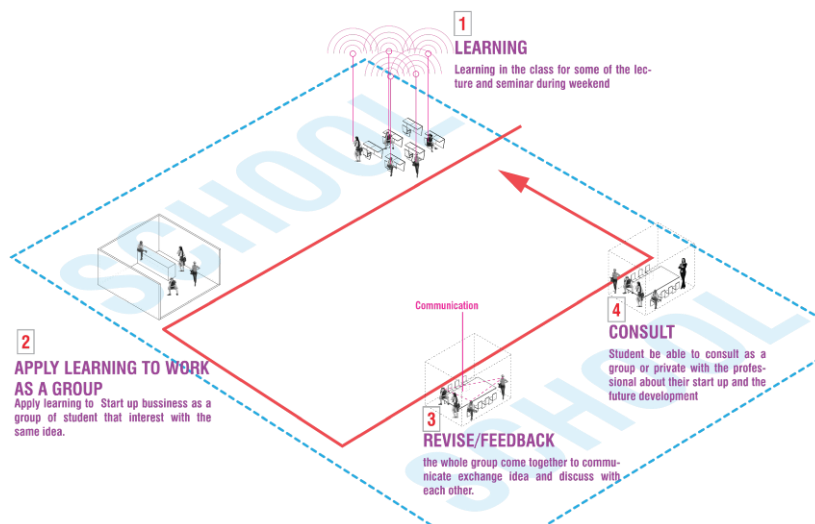
Figure 13 Office worker learning process and learning Loop

Local business learning process

For local business user, they will have a similar process to office worker. All the local business user be able to learn and gather knowledge resource from cloud technology and be able to apply their knowledge through working process on their own business and receive feedback from real client and professional consultant.
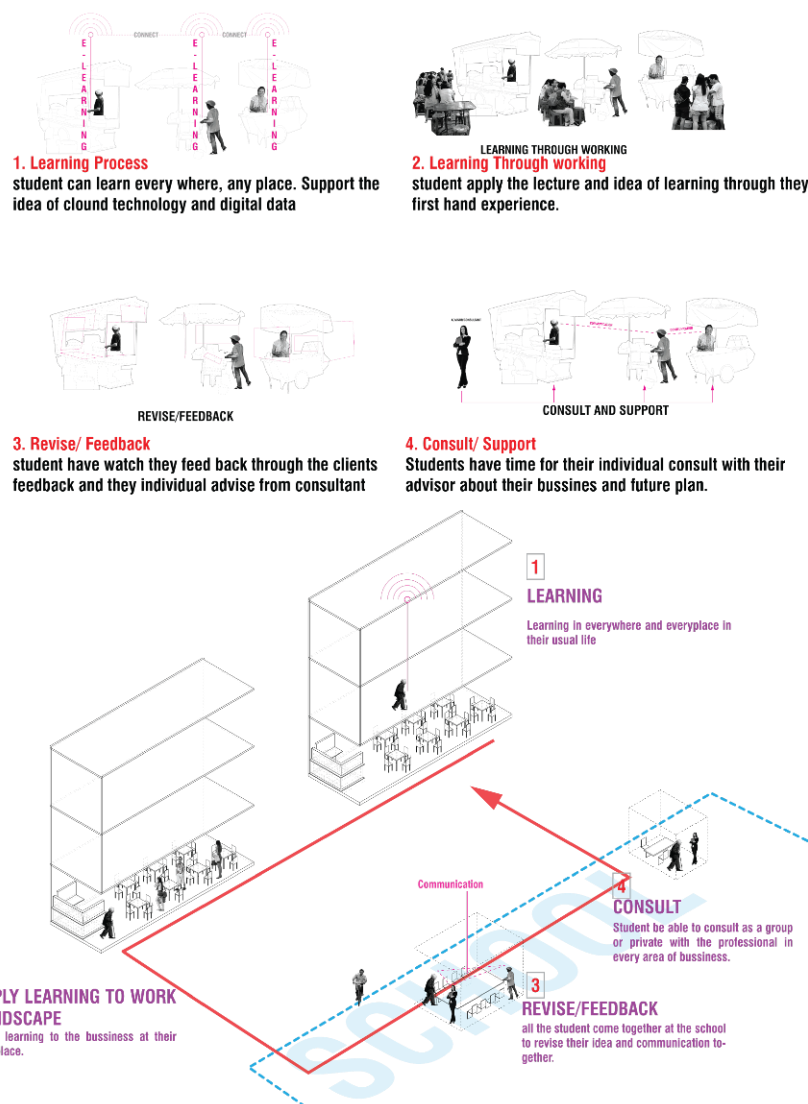
LEARNING PROCESS
Local Business

1. Learning Process
student can learn every where, any place. Support the idea of clound technology and digital data

LEARNING THROUGH WORKING
2. Learning Through working
student apply the lecture and idea of learning through they first hand experience.

REVISE/FEEDBACK
3. Revise/ Feedback
student have watch they feed back through the clients feedback and they individual advise from consultant

CONSULT AND SUPPORT
4. Consult/ Support
Students have time for their individual consult with their advisor about their bussines and future plan.

1
LEARNING
Learning in everywhere and everyplace in their usual life

Communication

4
CONSULT
Student be able to consult as a group or private with the professional in every area of bussiness.

2
APPLY LEARNING TO WORK LANDSCAPE
Apply learning to the bussiness at their own place.

3
REVISE/FEEDBACK
all the student come together at the school to revise their idea and communication together.

Figure 14 Local business learning process

CONCLUSION

Impact of working class in Creative Era

The rise of creative class all over the world has been impact to our way of living and a future of our culture. According to Florida, a second industrial revolution because of increase technology development in advance transportation that resulted in an economic boom for western nation. Social Constructivism lend itself to the 21st century learning development. Since the way of education has been processed in line with demand of standard industrial operations. Lev Vygotsky suggested that Human Development and Construct Knowledge through the social Interaction learning could provide a more dynamic combination of competent workforces in creative economy. Social Constructivism and Historicism has unveiled structure of the curriculum which reflects timeline of Chareonkrung District. The fundamental transferrable skills are mostly aligned with innovative and advance technology: system thinking, logics, communications (Global perspective). The value-added skills

are aligned with the skills on which current business and industry is operated. (practice of economic activities) The unique skills derived from cultural identity which embedded within the local wisdoms and knowledge. (Historicism approach towards urban workforces)

A good collaboration between local training center, Thailand creative design Centre (TCDC), and reasonable study curriculum to create a better tomorrow

Thailand creative district Centre (TCDC) and Creative district can be described as a good solution of knowledge and business support for people but to fulfill overall of the project. It requires a collaboration and understanding to other elements of the program and district. Program that will be able to give a 21st century knowledge and update of technology to allow local business, local people, and other user adapt their self with the future. Some of the curriculum and study program has been analysis and conclude from the above paragraph. A solution for this situation requires a collaboration between government section (TCDC, Creative district, University) and private sector will help to enhance an ability of the program to provide a more effective impact to Charoenkrung for 21st century.

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CASE STUDY: THE JOURNEY TO EXPERIENTIAL LEARNING IN PASSIVE DESIGN

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INTRODUCTION

There are many sources advising teachers to adopt innovative learning methods to improve students' capability in relation to critical thinking, creativity, depth of learning, etc. [1-4]. However, there are many reasons why such a transition can be difficult. These include the teacher's belief in the extensive lecturing approach as it reflects their own successful experience [3], lack of training to support new methods [1], and lack of time and resources to implement such an extensive change [3, 5].

There are a number of innovative learning methods advocated, e.g. experiential learning [6], collaborative learning [3, 7], backward design process [2], problem based earning [2, 7], flipped learning [5, 8], gamification [9] and others. There are also several technological approaches suggested to support these learning methods e.g. audience response systems [8], videos [5, 8], digital simulation [7] and e-learning platforms with features such as forums [7].

Selecting the appropriate approach for the specific cohort and topic is a challenge. This paper describes how this challenge was approached in relation to transforming learning of Passive Design at Post Graduate level in the Welsh School of Architecture. The topic had previously been delivered in a traditional lecture-based format with lectures recorded for distance learners.

SCOPING PARAMETERS

The most important aspect to consider is the student cohort. In this case, there are two cohorts: local students and distance learners. Due to scheduling, some of the distance learners take the module later in the year. Across both cohorts, there is a high proportion of international students for whom English is not the primary language. Within the distance learner cohort, there is a very high proportion of part-time students with the associated limitations on study time availability and quality [10]. The students have a range of academic backgrounds (e.g. Architecture, Landscape Architecture, Engineering, Interior Design). Architecture students have been found to learn more readily from visual and active approaches rather than verbal or reflective approaches [11].

The scheduled delivery time (five sessions, each of four hours), available teaching space and facilities are also considered as scoping parameters.

SELECTION OF APPROPRIATE LEARNING METHOD

When considering a departure from traditional lecturing as a teaching method, there are a bewildering number of options to take, all with literature indicating their success in at least one scenario. A selection of these were indicated in the introduction. Information on these options were gathered from academic and grey literature [12-14] and conference presentations as well as discussions with colleagues. From this a list of broad categories was created and those which had potential for inclusion were highlighted (bold):

- **Lecturing**
- **Reflective learning**
- **Experiential learning**
- Workplace learning
- **Group work**
    o **Problem / Case based learning**
    o **Peer teaching**

Experiential learning was selected as the main strategy because of its reputation for encouraging deeper learning [6] and because it could incorporate other learning methods. This is illustrated in Figure 1.
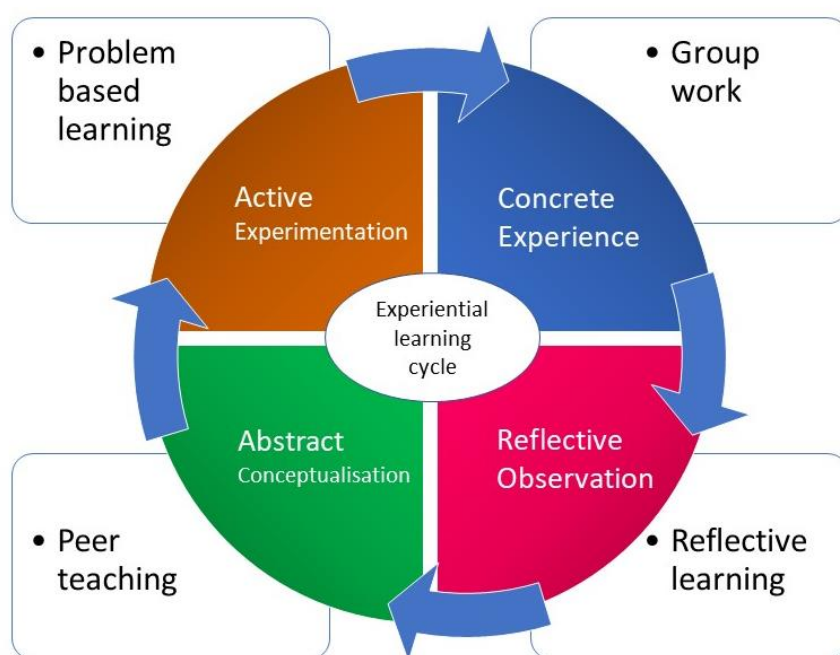
Figure 1. Illustration of Experiential Learning Stages and relationship to other innovative learning methods

APPLICATION OF EXPERIENTIAL LEARNING TO PASSIVE DESIGN MODULE

Appropriate learning opportunities were designed for each of the Experiential Learning stages.

Concrete Experience

The first stage of Experiential learning (Concrete Experience) was facilitated by designing activities to allow groups of students to explore key themes of passive design:

- Passive solar heating
- Natural ventilation
- Vegetative cooling.

A fourth activity – the "Bundle-Up! Game" developed by Mark DeKay [15] was also used. Images of the natural ventilation investigation are presented in Figure 2.
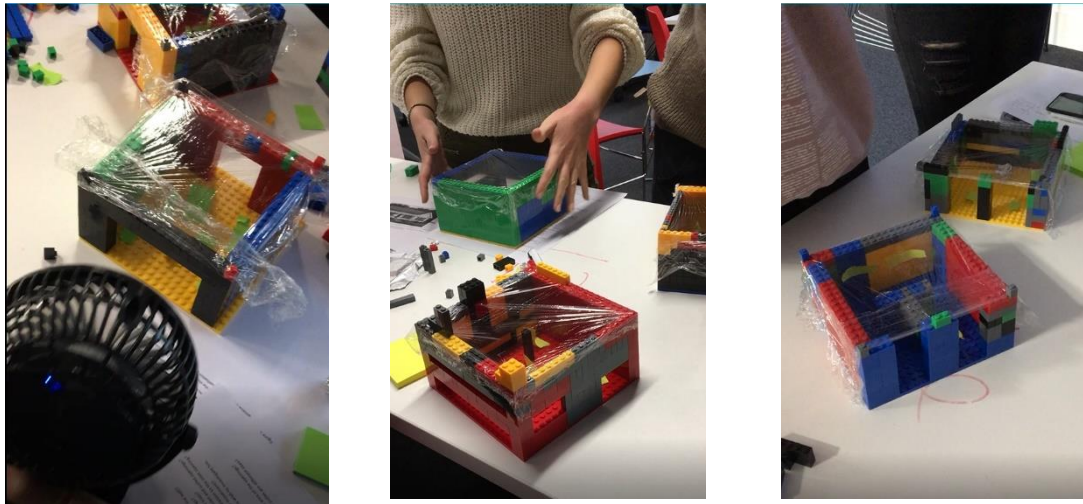

Figure 2. Images showing natural ventilation investigation being carried out

Reflective Observation

In the second phase (reflective observation), students were aided in reflection by being posed questions in two formats.

- Initially questions were posed in the activity brief (during "concrete experience") to guide the students investigation activities.
- Additionally, for each theme, a quiz has been developed.

The quiz questions are posed to all the students. However, it has been recognized that some students find it difficult to ask or respond to questions publicly due to modesty or concern about loss of face [16]. However, it is important to encourage these students to participate, as otherwise it is very difficult for the teacher to gauge student understanding and to present information in a different way if there is a misunderstanding. To enable all students to participate, an audience response system (PollEV) was adopted; this allows students to respond on a mobile device using the local Wi-Fi connection. Audience response systems can facilitate a wide range of question types including multiple choice, open ended, ranking or even selecting an image. Some students prefer to respond verbally which is welcome and enables further discussion. Figure 3 shows an illustration of a multiple-choice question being presented to the students, followed by an explanation.

Figure 3. Quiz presented in collaboration with audience response system:
a – presents the question, b – shows the responses, c – shows the correct response,
d - provides additional information for discussion

Abstract Conceptualization

The third stage (abstract conceptualization) occurs when students make sense of the experience so far and draw conclusions. Two opportunities for this are given to the students.

Firstly, each student group is asked to present their findings from the activity. This has the potential to incorporate peer teaching, particularly if a member of the group is struggling to grasp the concept. The presentations are recorded and made available on the Virtual Learning Environment (VLE) and are also a resource for any student who was not available to participate in the activity.

Secondly, the summative assessment for the module asks each student to consider one passive design strategy in detail with the aim of explaining:

- What need does the passive design strategy respond to?
- How would it be applied?
- How would it perform?

Active Experimentation

The final stage of experiential learning (active experimentation) takes place in a related project module utilizing problem based learning. The project module requires students to relate occupant requirements throughout the year in a specific climate to appropriate passive strategies which may not operate in a complementary fashion. The students have to:

- prioritize the needs of the occupants,
- considering appropriate ways of integrating the passive design strategies into the building design,
- evaluate the effectiveness of the strategy (including the sensitivity of the building response to variants on the design),
- refine the design to optimize occupant comfort throughout the year.

This activity fully proves the students capability to conceive, apply, analyze and evaluate – all of which are considered evidence of deeper learning in Blooms Taxonomy [17].

LOGISTICS OF APPLYING EXPERIENTIAL LEARNING TO PASSIVE DESIGN MODULE

Although there are many classifications of learning styles, the overall message is that different people have different learning preferences. For this reason, "lectures" were still required; however, there is a wealth of literature over decades, indicating that student concentration reduces after approximately fifteen minutes of passive learning [18, 19].

Since contact time was required for interactive activities, it was decided that a series of short (less than fifteen minute) lecture podcasts would be pre-recorded. Students would be asked to review the recordings or accompanying written notes before the interactive sessions in a "flipped-learning" approach.

The key ambitions in preparing the visual materials were:

- create concise presentations which would communicate key points within the passive concentration period
- show examples of the passive design strategies being applied in relevant climates
- provide high quality visuals to satisfy the high visual standards of modern students, particularly those involved in architecture.

After completing the recordings, it was found that the lecture material had been reduced to four hours and twenty minutes for the entire module.

The combination of the flipped-learning approach with short recordings or written notes gave the following advantages to the students:

- choice of format for preparation (short recorded presentations or written notes)
- all pre-recorded materials are available from the start of the module. This gives students a choice of when and where to prepare for the interactive session and to balance their overall workload from week to week.
- ability to break up the recordings to fit into their own schedule as there is no requirement to watch all the preparatory materials for a session in one sitting. This allows the students to take natural breaks and recover their concentration
- allows students whose first language is not English to deal with any language issues in a non-pressurized environment. In traditional lectures, students can find it difficult to look up words they are not familiar with without losing track of the topic and are often reluctant to ask for clarification of words.

Practitioners are invited to give guest lectures in the contact sessions. These presentations are also recorded and made available on the VLE.

Distance Learners

During the module transformation, it was important to remember the requirements of distance learners. As they are not available to participate in activities during contact sessions, briefs were adapted to enable these students to carry out their own version of the activities.

The VLE contains a forum to enable all students to communicate amongst themselves and with the module leader (although students make limited use of it). Students are also able to contact the module leader directly via e-mail and this communication method is used more frequently. Responses to individual student questions are then announced to all students using the forum as it is considered likely that more than one student will benefit from the clarification.

REFLECTION ON IMPACT OF THE MODULE TRANSFORMATION

Students were asked for their views on the module transformation. Students could respond to questions verbally or using the audience response system. The main findings were:

- Students showed a strong preference for short, pre-recorded lectures over long lectures and over written notes
- appropriate amount of time available for quizzes, discussion, guest lectures
- even more learning activities were wanted, although this could not be provided without increasing the overall time allocated to the module
- all learning activities were found to be valuable

Students also provided the following comments in their module evaluation feedback:

- "I loved how in-depth each short video was and liked the fact that all material had been uploaded for viewing weeks before the module had begun" (Distance Learner)
- "I really enjoyed the module and found it a lot easier to digest the shorter presentations … than the longer lectures in other modules" (Distance Learner)
- "A number of activities helped us to understand the reason of the strategies" (Local Student)
- "Interactive class sessions. Reading first, applying later in class was helpful and fun to learn the principles" (Local Student)

CONCLUSION

Transforming the passive design module to an experiential learning approach has been a significant investment of time. However, it has been possible to spread the process over three academic years. This involved trialing different activities and developing the short, pre-recorded presentations. As with any module, the development is never considered as "finished" - further developments are still being implemented (e.g. creating new activities, revising pre-recorded lectures). However, the framework for the module is now established.

The Experiential Learning approach to the module has been delivered in the last two academic years. There has been good attendance at activity sessions, and students appear to derive significant benefit from them. To have the phrase "fun to learn" addressed to the module by a participating student is considered as a significant compliment.

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REFLECTION ON THE PRACTICAL DESIGN COURSE BASED ON SINO-FOREIGN JOINT TEACHING——TAKING SDC2018 SINO-GERMAN JOINT TEACHING AS AN EXAMPLE

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INTRODUCTION

In order to promote the development and application of solar energy building technology, a series of solar energy architectural design competitions have been held in China and abroad in recent years.[1] Among them, "Delta Cup International Solar Energy Architectural Design Competition" and "International Solar Decathlon Competition" have had the greatest influence in China. Compared with the former, which is based on drawing submissions, the latter focuses on the on-site construction and marketing of solar residential houses and is the only competition to evaluate completed buildings.

The Solar Decathlon (SD) is a solar building technology competition sponsored by the US Department of Energy. Since 2002, the competition has been successfully held in Washington, USA and Madrid, Spain[2], and has been gradually extended to China, Europe, the Middle East, Africa and Latin America. The competition requires each team to build a solar house within the specified time, and the built house is inspected based on ten criteria, including architectural design, on-site construction, and marketing. In 2011, the National Energy Administration of China and the U.S. Department of Energy signed a cooperation agreement for the "Solar Decathlon Competition," which started Solar Decathlon China (SDC). In 2013, the first SDC was successfully held in Datong, Shanxi in China. 22 teams participated, with participants from 35 universities and 13 countries. SDC2018 was the second iteration of this "Green Building Olympics", with a grand scale and complete supporting facilities. Teachers and students from 34 universities and 8 countries and regions built 19 solar houses.

In addition to architecture design, the competition involves technology and other related knowledge, challenging the traditional architecture design teaching mode with design curriculum as its core. Function, form and space are the core topics of architectural design colleges in China. Architectural design is the focus of teaching.[3] "Emphasizing design while neglecting technology" is prevalent in curriculum design.[4]Based on the internationalization platform of SDC 2018, the School of Architecture of Southeast University and the German Brunswick University of Technology—which is more advanced in solar architecture technology research—jointly participated in the competition and

took this opportunity to carry out Sino-German joint teaching to explore teaching methods suitable for practical design.

This paper records and analyses the whole process of teaching design and construction from the perspective of teachers and students who participated in the competition. First, it discusses the course's joint foundation, organizational structure and teaching process. Second, it compares and analyses the similarities and differences between the course and traditional design courses by reviewing and reflecting on the collision and integration of "space-and-form-based" and "technology-based" ideas in this Sino-German joint design course. Finally, by analyzing problems in real construction, this paper summarizes aspects that need to be further improved in the course.

COMPETITION AS A TEACHING PLATFORM

Joint Foundation

Competition is especially useful as a teaching platform because it includes global issues. Developing and developed countries in different stages of urban development faced different market demands. However, energy sustainability and healthy living are still global topics. The development of solar energy technology is considered to be one of the key solutions to meet the growing global energy demand.[5] Design development directions such as aging design, shared space, economics of photovoltaic buildings, and high-rise development of solar houses have become global trends in solar house design.[678910]

Based on global issues, international joint teaching has become an important method for architectural colleges to expand their professional education and broaden their international horizons.[11] More than half of the teams participating in SDC2013 and SDC2018, for example, were multinational teams. The School of Architecture of Southeast University and the Technical University of Braunschweig of Germany took their joint participation in SDC2018 as an opportunity to sign a university cooperation agreement, jointly discuss stable scientific research and personnel training mechanisms, and carry out joint teaching of solar energy architecture. The SD-based international communication platform and exchanges with German engineering colleges made up for a possible lack of technical knowledge in the architectural design curriculum of Southeast Architecture College, while China's local culture and broad consumer market were attractive. Overseas education and design personnel, and the exchanges and cooperation with Chinese universities, provided a crucial platform for the promotion of German solar technology in China.

Organizational Structure

A competition based on practical design creates opportunities for design teaching as well as challenges. The main goal of modern architecture education is the cultivation of practical architects. Therefore, the indispensable practice link in the architectural design teaching system has become consensus among architecture colleges. How to integrate the design course with the competition practice and how to match the design results with the competition requirements are the key and difficult points of this Sino-German joint teaching course. In the arrangement of teaching time, the main consideration of the practical design curriculum is the submission node of the organizing committee, and the overall planning of teaching activities is carried out according to the course assessment time of the college. At Southeast University, for example, in traditional practice courses, it often takes several months or weeks to submit relevant reports and drawings. But SDC, is about the real house construction, encompassing comprehensive knowledge. Because of this, students with high grades were recommended to join the competition. It offered a good chance for practical design,

through the long duration of the competition brought many challenges for teaching schedule arrangements.

	Curriculum	Grade	Duration	Teaching Content	Teaching Achievement/Assignment
Traditional Practice Courses	Design course	Undergraduate, graduate students	8 weeks	Design and drawing	Design drawings, rendering models or hand-made models
	Site internship	Third year of undergraduate	2 weeks	Site visit	Internship report
	Design institute internship	Fifth year of undergraduate; second year of graduate	6months	Participate in actual engineering projects	Construction drawings
Practical Design	SDC2018 joint teaching	Fifth year of undergraduate; first year of graduate	2years	Architecture and engineer design; market promotion; on-site construction	Design drawings; construction drawings; operational house

Table 1. Comparison between traditional design courses and practical design

In terms of personnel composition, the Chinese side comprised mainly teachers with architectural backgrounds, and the German side comprised mainly teachers with engineering backgrounds. According to the ten scoring criteria of the competition, the Chinese and German sides had mixed groups. In order to give full play to the disciplinary advantages of the two schools, the Chinese students were mainly the students of architectural design and theory, with some students of architectural technology science, while the German students were mainly students of engineering design, with some students of architectural design. Compared to the continuity of the competition and the long schedule, the courses were fragmented and short-term. At the end of each course, the next course needed to be set up to complement staff schedules. The mobility and uncertain schedules of the personnel challenged the continuity of the project, so students were encouraged to continue working as volunteers after the course.
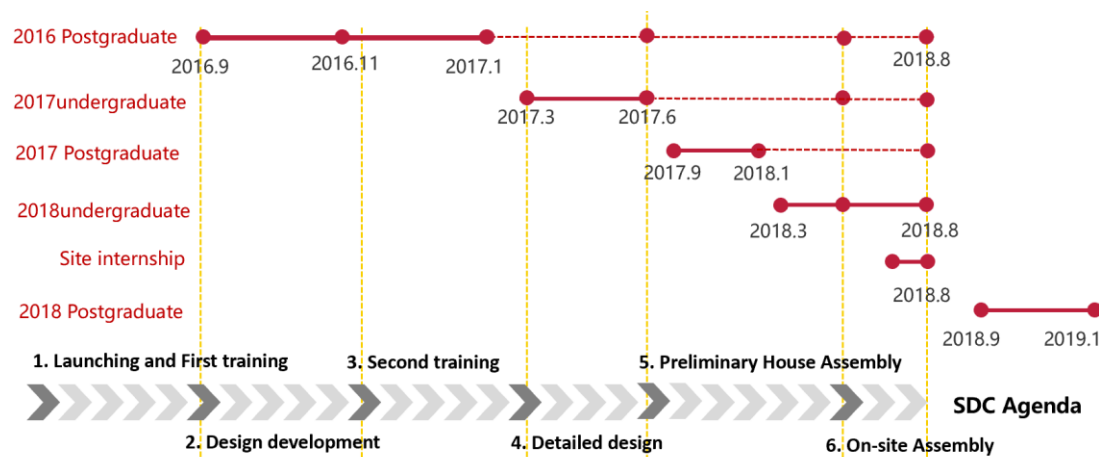
Figure 1. Timeline of curriculum structure& competition at Southeast University

Teaching Process

The teaching content of the project can be divided into three stages: design and discussion, simulation and experiment, and construction and evaluation. In addition to defining a preliminary design plan, it was crucial to find a way to cooperate. In Nanjing, China, German and Chinese students conducted centralized teaching. They discussed cooperative programs through reporting student programs, exchanging program design, and teachers giving special lectures both inside and outside the school. The preliminary conceptual scheme gave full play to the respective advantages of the two schools and the cooperation between the two sides in different areas.

The designed house was called the C-house. 'C' refers to "core" and "cube." The house looks like a compact cube from the outside, with an integrated core in the center. The integrative approach was mainly applied to the "core." This modular component was prefabricated in Germany and contained all necessary service functions, including kitchen, guest toilet, bathroom and an extensive technical room. The technical room included all technical services, including energy management, cooling, heating, air purification, energy storage, and so on. In the past decade, the market's focus on BIPV systems has been paralleled by the overall development of photovoltaic cell technology, and the reduction in photovoltaic panel costs has made BIPV investment feasible.[12] The development of advanced BIPV products is now almost a replacement for all building materials. With the popularization of photovoltaic systems, energy-saving design is no longer demanding in architectural design, and the exploration of healthy buildings and photovoltaic building integration has become a more important research direction. The north and south façades were glass curtain walls, while the east and west façades and the roof were covered with a continuous energy skin (photovoltaic panels). In terms of division of labor and cooperation, the German side made full use of its technological advantages to develop the core in Germany and transport it to China, while the Chinese side made full use of its advantages in design and rapid construction, and was responsible for the construction of the structure, space and skin of the house.

Figure 2. Concept of C-house

After the first stage of centralized teaching, the German teachers and students returned to Germany and communicated with the Chinese through weekly remote videos. At this stage, according to the division of labor laid out in the first stage, China and Germany carried out teaching activities separately. In addition to traditional lectures and sharing of special reports, the Chinese side mainly conducted on-the-spot teaching through physical technology exhibitors and the actual construction of related buildings, while the German side mainly used the school's laboratory resources to simulate the building's performance. During the design teaching period, the School of Architecture of Southeast University organized students to carry out product exhibitions using light structures and expand information exchange with the larger market by taking advantage of resources around the school such as the Green Building Expo and the low-carbon technology product exchange meeting. At this kind of exhibition, in "output" and "input" teaching modes, students can expand their design depth by exploring market-related cutting-edge products and obtaining corporate sponsorships. Taking advantage of the opportunity of campus reconstruction, the course provided students with participation in the full process of factory production, dismantling and re-engineering, enhancing students' hands-on, initiative and creative abilities. The German teaching fully utilized the advantages of the technology development of German universities, testing and simulating core technologies in the laboratory and sharing test data in real-time on a shared resource platform. In addition, the German side organized a study on solar houses that had achieved outstanding results in previous solar competitions and learned in physical space. The Chinese side was responsible for deepening the "periphery" of the house's structure, building and interior space. The German side's cooperation in the research and development of the built-in core tube continued into the final stage of the construction.

COLLISION AND INTEGRATION
The experience of the joint teaching can be summarized as "collision and integration."

"Space and Form-based" and "Technology-based"
Due to differences in professional backgrounds between the Chinese and German participants, there were two directions in design. One was space-based, and the other was technology-based. Architectural design only accounts for one-tenth of scores in the solar decathlon, but from the initial

phase of the design, architectural design still plays a leading role, especially for solar houses. Chinese students had less awareness of "technology" and were characterized in the design as not confident in the use of technical techniques. The design of the program was based on the team's resources. On the basis of technical self-confidence, the German students paid less attention to architectural technology in the early stage of design, and their formal considerations were simpler and more direct. Facing the Chinese market, the Chinese students' enthusiasm for the form and space of the traditional Chinese "slope roof" and "company" courtyards caused intense discussions in the exchanges between the two sides. The space design that the Chinese students thought was natural and reasonable should have collided with the simple design of German modernism. Correspondingly, both sides had their own emphasis on the selection of solar energy technology. Brunswick Polytechnic University in Germany advocated the use of "energy plus" design as the main active technology, while Southeast University advocated the maximization of passive energy-saving in traditional Gallery building form.

Disunity of opinions usually leads directly to low design efficiency and doesn't create significance for the high and low content of formal space. When the architectural form is uncertain, how can a rational architectural design be established? In the end, the Chinese and German sides chose a traditional architectural plan based on analysis of existing resources, division of labor and cooperation, and technical learning to ensure high-quality, convenient collaborative work.

Figure 3. "Space and Form-based"

Figure 4. "Technology-based"

Educational System and Competition

Essentially, students participate in design courses to get credits. Based on competition, the practice design course provides more opportunities for students to learn, but from the perspective of completing the project, the change of personnel does not make use of the promotion of the project. The content of the courses at different stages should correspond to the grades of students. Therefore, in terms of competition time and organizational content, the organizing committee may coordinate the curricula of various colleges and universities.

Scores in the competition are very important for teaching evaluation. From 2002 to 2017, after more than ten years of development, SD in the United States matured in rulemaking, operation and implementation. [13]SD in China was introduced from the United States, and the competition organization structure, rules, execution, etc., have all been in line with the U.S. SD, such as government organizations, corporate-sponsored exhibitors, university research and developed cooperation models of industry research; the ten individual items from the referee's subjective scoring and equipment objectives; the scoring methods of the two aspects of the survey; and education and teaching promotion methods as the transmission path, etc. With the development of SD in China in the past few years, the 2018 China SD adapted competition organization and rulemaking and included some localization features. Comparing the scores of subjective evaluations of SD2017 and SDC2018 shows that the scores of the American referees were relatively independent, and the differences between the five scores were significant, while the scores of Chinese teams had a certain "convergence", that is, the five scores for each team were comparatively similar. From this point of view, each SD referee in the United States seemed to pay more attention to the characteristics and outstanding performances of individual events, while SD referees in China were greatly influenced by the overall impression of the house and the level of completion. We don't know which is better, so the evaluation systems still need to be discussed.

Figure 5. Scoring Standard

REFLECTION AND SUGGESTIONS

In August 2018, the Southeast-Brunswick University of Technology team in Dezhou, Shandong Province, spent 14 days building the real house, and then carried out the performance test and operation simulation of the house. In the end, the house won the third-place architectural design award and was the third in overall score. The process of actual construction and testing also showed the shortcomings of teaching courses that can be improved in the future.

Continuous docking with the manufacturer during the design process:

During the process of joint teaching, docking and negotiation with the manufacturer did not go deep into the product level, which led to many uncertainties in the selection of products in later construction, and some schemes even needed to be overturned and re-established. The market attraction of housing and the nature of cooperation with enterprises need further reflection and improvement. To some extent, the stability of corporate sponsorship determines the feasibility of housing construction.

Deepening drawing fineness and control

Both detailed design and local construction technology level should be taken into account in the construction drawings. Unlike the conceptual design drawings or schematic design drawings in previous design courses, the construction drawings required in this competition required higher completeness and precision. However, in the actual construction, it was found that the site construction did not require the design depth of the drawings. Some flexibility and primary and secondary distinction are needed.

Simulating housing operation

Because the core barrel part of the integrated equipment and the main envelope of the building were respectively the responsibility of Germany and China, errors inevitably occurred in the process of combining the two parts. Performance tests for the core barrel were carried out in the laboratory of the German school, but the capacity value of the core barrel in the actual operation process could not be accurately estimated. This also led to air conditioners needing to be added during the tournament because of the lack of cooling in the houses.

Professional safety training for students and student-centered competitions

The International Solar Decathlon Competition is a competition for students that aims to promote solar energy education. However, due to insufficient safety training for students, the main construction work was still essentially completed by employing workers. In addition, due to limited time for centralized communication, teaching needed to be carried out in all weather, which conflicted with the original curriculum in the teaching system to a certain extent. Joint teaching provides more possibilities for architectural education through cross-international, cross-cultural and cross-disciplinary teaching methods, but at the same time also raises more demands for system reform. Therefore, while expanding openness, the normative system should be explored further.

NOTES

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REINSTATING THE DELIGHT IN ARCHITECTURE- A CONVERSATION OF SELF WITH THE SPIRIT OF THE PLACE

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INTRODUCTION

In the nature of space is the spirit
and the will to exist in a certain way
Design must follow closely that will
Therefore a stripe-painted horse is not a zebra… Ar. Louis Kahn[1]

The present state of architecture calls for serious introspection. Undoubtedly, our cities are clean, efficient, technologically superior and more comfortable than they ever were. But have they have lost the human connect? Have they lost the bond to the spirit of the people who throng it? Or has it become just another self-contained monster contributing data on lifeless parameters? As we ask ourselves these questions, important insights emerge!

Has architecture shifted from a sensory and emotional art form, engendering to a utilitarian and consumer-based one in the post-industrialization era? Has it been reduced to replicating inert structures driven by a growing consumerist society? And, has the architect been reduced to a thoughtless provider of unimaginative, disconnected superficial spaces?

Today's architecture snubs the connect between people and their culture. It lacks the 'sense of delight' for the perceiver, it ignores the creation of space – an architectural compulsion and undermines the role of the creator of the experience - the architect! This classic relationship between the space, perceiver and creator is being stretched and threatened. The gap between the two players – space (site), and the Self (both that of the creator, or architect, and of the perceiver, or client) has to be recognised as the biggest contributor to dull and listless outputs that now crowd our cities. Architecture has been reduced to a mere physical entity ('space'), devoid of thought and spirit; the 'perceiver' to a client with societal needs; the 'creator' to a mere trouble shooter! These reductions have not only impacted and shaped architectural practice but have also invaded pedagogical discourses and practices.

In a quickly modernizing world, is the disconnect between the Self and the World a fundamental gap in interaction? Architecture has been reduced to a series of images; images that change fast and continuously. This increased consumption of images has made us less impressionable when presented with a strong image.

We are interacting with the world as consumerists, bearing no emotional resonance towards the spirit of the place and, therefore, feel no Delight.

DWINDLING DELIGHT

The Cacophony of Images

As stated in the book 'The Embodied Image by Juhani Pallasma', in today's world of mass consumerism, globalization, worldwide economics and accelerated communications, we are ceaselessly bombarded by visual images.[2] Our physical world, cityscapes and natural settings, as well as our inner mental landscape are all colonized today by the image industry.[3] This limitless production defeats the purpose and don't go beyond the visual, weak substitutes of the original.

'There is a danger when every building has to look spectacular; to look like it is changing the world.' says Ar. David Chipperfield.[4] The exercise of creating a building is reduced to a mere exercise in form, a spectacle, ready and waiting to be captured by a lens.

'In the intoxicating world of the image, the aesthetics of architecture threatened to become the anaesthetics of architecture,' says Neil Leech.[5] In another quote, he offers the source of this problem: the increasing lack of communication in what he calls the "culture of the cocktail", where "meaningful discourse gives way to strategies of seduction, and architectural design is reduced to the superficial play of empty, seductive forms".[6]
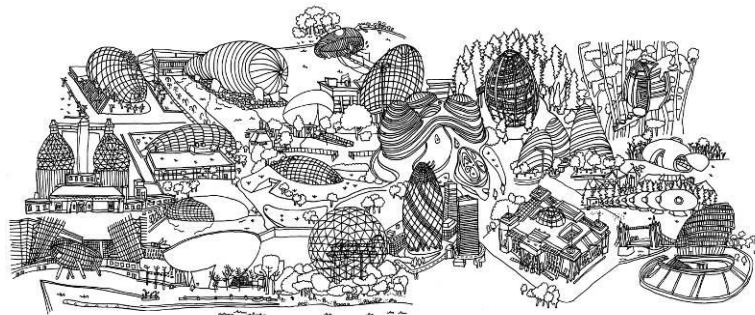

Figure 1. Dehond's eggceptional collection of illustrations, inspired by some of your favorite structures from all over the world[7].

Would the mindless production and reproduction of image lead us to the experience of delight?

Moorish architecture states that true beauty results from that "repose which the mind feels when the eye, the intellect and the affections are satisfied, from the absence of any want". In an increasingly consumerist world, the lack of beauty freed from this "want" creates significant detachment between the perceiver, the creator and the art itself.[8]

In his book, *The Nature of Order: The Phenomenon of Life*, Christopher Alexander states that it is imperative to "understand space as a material which is capable of awakening". This awakening occurs when a center "gets more life", which it gains through a stronger association with "the human 'I' or 'Self'". When this association arises, it creates a clear sense of what Alexander calls "space awakening".[9]

Architect Tadao Ando would arrange the spaces where each element is part of the experiencing engulfing the onlooker to connect to the beauty of the space- here, architecture goes far beyond mere functionality.

Charles Correa's *Bharat Bhavan* is a prime example of architecture that successfully engages with the 'spirit of the place' in order to create a building that truly inspires delight. People across time and physical space, often feel a universality of association. This association may have to do with shared cultural contexts, social memories or universal narratives. Correa engages directly with these ideas in his work, creating a building that engages as much with its (contemporary) surroundings as it does with the rituals, history and spirit of the people it was built for.

Does delight stem from discovering the soul and spirit of the space, from imbibing this soul to craft a work of art by the creator or is it the delight that the perceiver derives from the amalgamation of both?
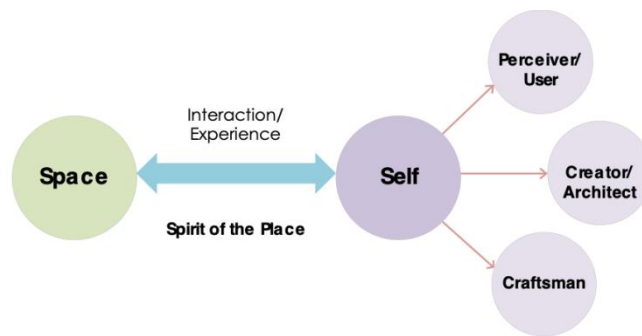
Figure 2. Spirit of the Place and the Self in the production of Architecture.

Spirit of the Place

Norwegian architectural theorist Christian Norberg-Schulz places phenomenological basis for philosophical reflection, in order to return to things themselves thinking, to discuss the construction of the essence, the spirit of place (Genius Loci) comes down to the core content for the construction of phenomenology, reveal the nature of the relationship between human existence and creation of architectural space.

Architecture has the power that helps one dissolve in the spirit of the place that is formless but equipped with all sensory delight.

DELIGHT IN ARCHITECTURE AND PEDAGOGY OF ARCHITECTURE

Review of various theories and works of architecture revolving around the idea of delight and spirit of the place indicate that the spirit of the place lies in the very interaction between the self and the site of intervention. In today's context where production of architecture is formalized, various forms of self are engaged in the process - ranging from the client, to the architect, to the contractor, to laborer. Each of these dimensions of the self is equally important. While bringing in the awareness of this association between the self and the site and the various forms of self, we at PVPCOA have been trying to stress exactly this. This realization has been informing the pedagogy of architecture at PVPCOA, where the aim is to enhance the interaction between the self (here student of architecture) and the site (space of intervention). (Fig. 3)
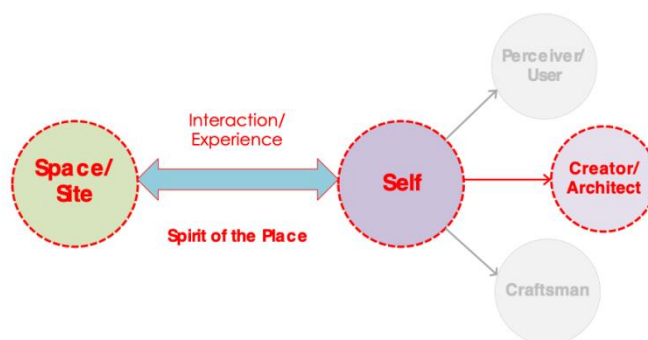
Figure 3. Spirit of the Place and the Self in the pedagogy of Architecture.

Space is everywhere, before it becomes architectural space. It is around us, in our imagination, perception, and in various art forms like literature, paintings, cinema, and music. Space provides ground for human existence, and hence it is in the purview of every human being. Thus, for students coming from various socio-cultural and economic backgrounds at PVPCOA, the idea of space and its experience forms the common ground to introduce them to the idea of architecture. For students in the first year exercises are focused on the understanding of space experiences and its assemblage. Here various disciplines of arts, both visual (paintings, sculptures, theatre, etc.) and non-visual (music, literature, etc.) are referred to for two purposes - one to understand the ways space experience is responded to and second, to understand the various techniques devised in each of these disciplines from which methods for architectural learning could be drawn. While some exercises are analytical to understand the tangible and intangible components of space experience, space –syntax, form-material-geometry-order, others are aimed at assemblage of space experience through design. In these exercises various methods like writing, drawing, painting, model making, etc. are employed to help students understand space experience through participation in the process of making. To develop intuitive understanding of the space experience, field visits, observation and contemplation are used. Relative Study Program (RSP) is aimed at this method of learning of architecture of the place as well as designing in the same context that would enhance the experience of that place. Places like Maheshwar, Hampi and Bundi have been studied through RSP.

Exercise – 'Seasons: Space for Celebration of Season'
The beginning of the synthesis of the understanding of space experience starts with the design exercise of 'Seasons: Space for Celebration of Season' popularly referred as Seasons' exercise at our school. Here students are expected to design a small space for oneself to enjoy the season that one likes. For our students, this is their first architectural design exercise. The methodology is devised by drawing methods and tools of understanding and synthesis of experience of a season from various art forms that is aimed at designing a small space for an individual to enjoy a season.

In India, there are six seasons, namely –*Vasant* (Spring), *Grishma* (Summer), *Varsha* (Monsoon), *Sharad* (Autumn), *Hemant* (Winter), *Shishir* (Winter). Due to the climatic diversity of India ranging from cold Himalayas in the north to the hot Thar Desert in Rajasthan to humid sub tropics of north east to tropical monsoons of the south-west coast, the degree of these seasons changes from place to place. This offers a variety of experiences. For this exercise, we refer to the seasons in Maharashtra as most of the students belong to this state.

Methodology

Overall the exercise is divided into multiple smaller exercises with three major stages: Analysis, Idea Model (contemplation) and Synthesis. *(Refer fig. 4)*
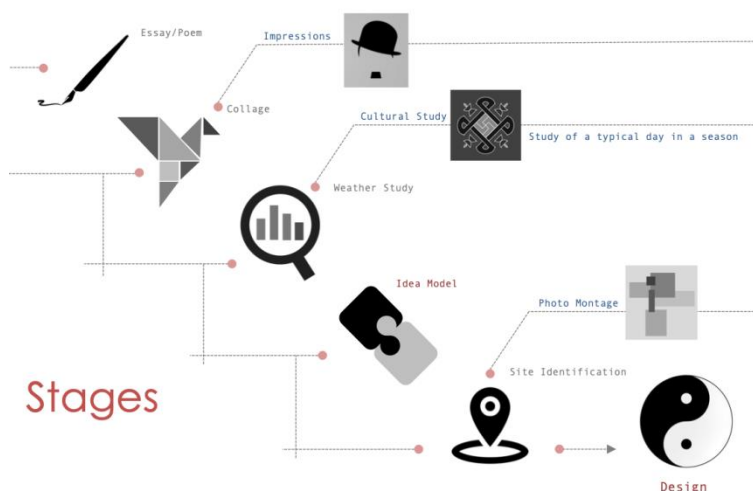

Figure 4. Exercise Framework (Methodology).

Stage-1: Analysis

The first stage of analysis is comprised of multiple smaller exercises aimed at establishing the multi-sensory understanding of the experience of seasons. This is done through a retrospective question: *what is the aspect of my favourite season that I enjoy the most?* And it is often followed by *'Why?'* While the first question helps students to understand the season along with its nuances, the second one helps them in understanding their own association with the season. The smaller exercises are comprised of writing an essay or a poem; making a collage, painting impressions of the season, climate and weather study of seasons, study of smellscapes, colourscapes, texturescapes, soundscape and foodscapes of seasons, culture study to know the festivals celebrated in every season. During the course of these exercises, *ragmala* paintings, literary works such as poems, folk songs, and the like are often referred to, to understand how a season has been expressed in various art forms. Each of these exercises are stand-alone exercises and not built on any earlier exercises. Each output of every exercise is discussed rigorously in a collective manner to make each student understand in how many ways one is associated with seasons and the experiences one is referring to.

Every exercise due to its nature provides a different insight into the experience and the association with the season. Students employ essays and poems as descriptive mediums to show their association with childhood memories and activities connected to a particular season. The poem below by student about here experience of season-*'Sharad'* (autumn) exemplifies this.

The time when you can live to it's fullest
When you can breath deep,
and smell the fragrance of the wind.
With the eyes wide open,
you can look through the sky.
When the sound of gushing stream,
can calm your soul
It's the time,
When every flower wants to bloom,
every tree wearing green dances with the birds

Yes it's the time
When autumn is arrived!

Exercises of collage and painting of impressions, which are graphic and visual mediums, gives possibility to express the intangible aspects of experience of season like color, texture and light that are difficult to explain in words. (Fig.5a, b, c)

Figure 5a. Collage depicting the experience of season 'Vasant' (Spring).

Figure 5b. Collage depicting the experience of season 'Sharad' (Autumn).

Figure 5c. Painting capturing the impression of season 'Varsha' (Monsoon).

Climatic study helps establish geographic and measurable understanding of the intangible dimensions of experience of a season. Culture study provides insights to the collective association of people with the changes happening in nature during the season, and how they are articulated through the celebration of festivals. Study of smellscape, colourscapes, texurescapes, soundscapes provides an opportunity to closely observe the changes happening in nature during various seasons strengthening

the multisensory dimension of the experience. Besides being able to understand the experience of seasons objectively, these exercises and the discussions following them help students build their architectural vocabulary of space and experience.

Stage-2: Idea Model

The second stage of 'idea model' is the crucial stage of the overall exercise, as from here on it changes from being a set of stand-alone smaller exercises to one to be built upon the earlier. This stage is aimed at discovering that singular idea about an experience of a particular season that one would like to take ahead in their design and provides an anchor to various design decisions ranging from identification of site to siting to form-geometry to construction materials and technology. The question that governs this stage: *what is the spatial-formal idea that is hidden in my favourite experience of a particular season for which I would like to design an architectural space? (or experience of my favourite season?)* Here 3D model-making is used as a tool to figure out the spatial-formal idea hidden in the experience of a particular season. This model is not necessarily a concept model of the architectural envelope that one intends to design and hence its not to any particular scale. For practical purposes of handling its maximum size is defined as 0.6mx0.6mx0.6m. (Refer Fig. 6a,b,c)
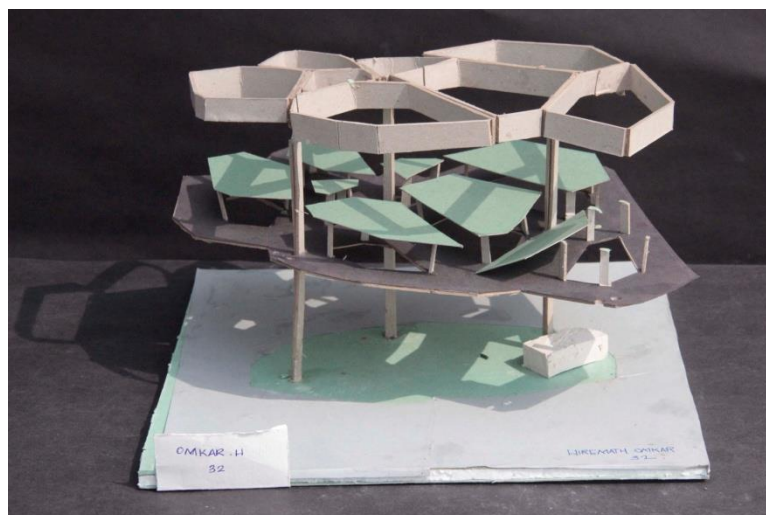

Figure 6a. Season 'Grishma' (Summer)- Light filtering through the layers of leaves of a tree.

Figure 6b. Season 'Vasant' (Spring)-Vibrancy of colors of the spring and festival of 'Holi'.

Figure 6c. Season 'Shishir' (Winter)- Crackling sound of shaded leaves under the feet while walking.

Stage-3: Synthesis

The third and final stage of the exercise is of synthesis i.e. designing of an architectural envelope for the experiencing the delight of the season that admeasures about 35-40 sqm of built space, and should be able to exist for 24 hours. Each individual student is expected to develop their own design program and design brief. This stage has two parts to it, one – construction of site and two –architectural design. Based on the experience of one's favorite season and the spatial-formal idea hidden in it, each student is expected to construct the site for their design. For the visualization and construction of the site, photomontage is used as a tool. This helps students visualize the natural setting and the features required in and around the site for the creation of desired experience. Here through discussions with students, teachers make sure that the sites students are visualizing and constructing are not emerging from fantasy but rooted in the real time geographic context set for the exercise. The site plan and site model is developed and drawn to a suitable scale from the photomontage. (Fig. 7a, b)
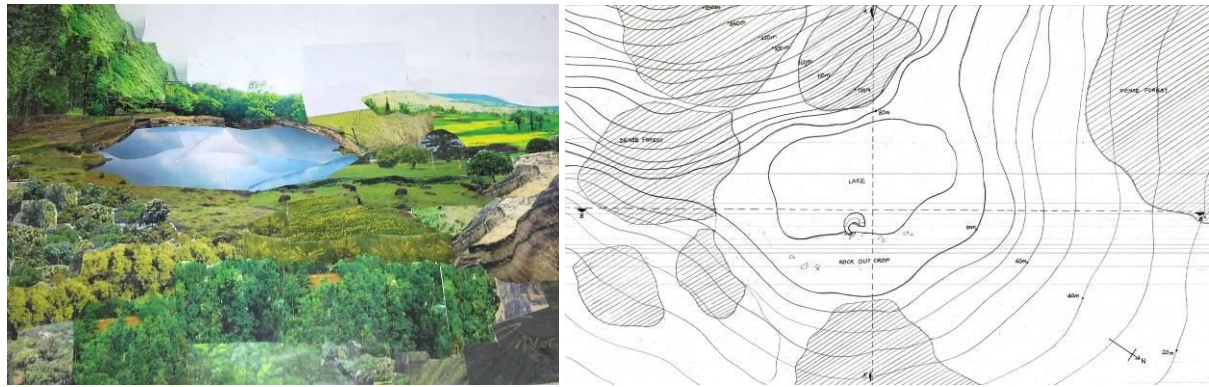
Figure 7a & b. Construction of Site through Photomontage and Site plan drawn from the same.

Designing of architectural space starts with model making and sketching. For the first-year students who are still not fully equipped with the tools of architectural drawing and graphics, model making and sketching become effective visualization and communication tools for bringing in the architectural resolution. During the process of designing form-space configuration, material-geometry and construction technology are stressed upon. The creation of the intended experience of the season, the prime aim of the exercise, helps students pay attention to all these dimensions of architecture at the same time. Therefore, neither construction technology and materials come as after thoughts nor the experience as a fallout of form making exercise. This establishes students' understanding of the inter relationship between material-geometry-form-space-experience-technology-landscape.
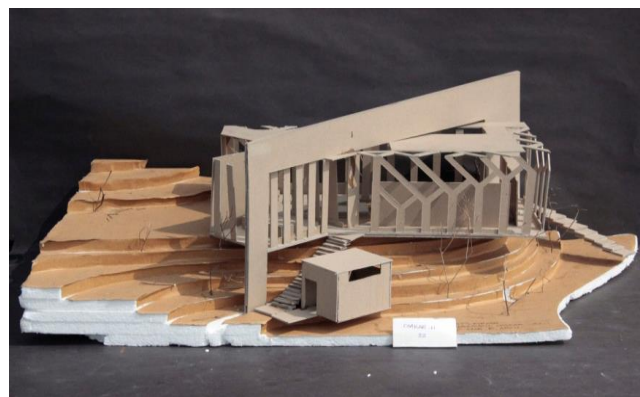

Figure 8a. Design for season 'Grishma' (Summer).

Figure 8b. Design for season 'Varsha' (Monsoon).

Figure 8c. Design for season 'Sharad' (Autumn).

Figure 8d. Design for season 'Shishir' (Winter).

All together, this exercise offers various ways and techniques to interact with the space of intervention through the idea of seasons and also ensures the participation of the 'self' in these interactions. Here creator and the perceiver are the same. Here architecture emerges from the contemplative, playful and intimate interactions between the self and space.

Student's Feedback

To test the success of this exercise that we have been now conducting since last four years and have improvised upon, a student's review was taken. It was focused on four major dimensions of the exercise - A. Understanding the concept of 'Spirit of the Place', B. Decoding experience of the season, C. Visualization and Resolution, and D. Reflection.
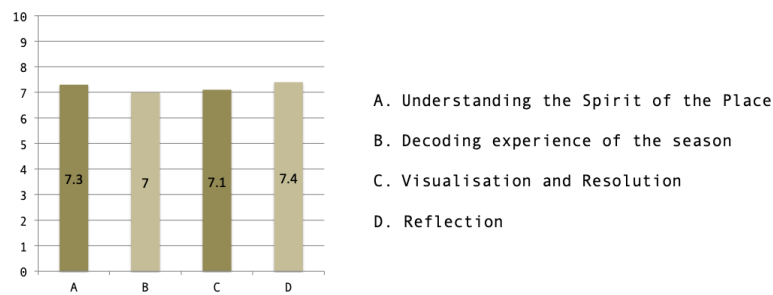
A. Understanding the Spirit of the Place

B. Decoding experience of the season

C. Visualisation and Resolution

D. Reflection

Figure 9. Student's Feedback.

CONCLUDING REMARKS

The exercises are drawn from an individual's (student) experiences, generating the idea of architecture that is more inclusive. The delight of architecture dwells in the architectural space designed which evokes feelings which has been epitomized by interactions between the creator and the site, a space that awakens emotions; inflames passion and kindles reactions.

Pedagogically the methods of learning of architecture need to be more a synthetic act than analytical. As today's architecture has become increasingly visual and reduced to a 'form making' exercise, there is a need to engage oneself to a place to realize the spirit of the place. This deep connection between space and architecture has to be recognised as a means to reorient the architectural design process. This has to be recognised as an important input in shaping the thinking of aspiring students of architecture.

It is important to recognise that a building as a space creates feelings much akin to emotions that interactions between humans evoke. As with human interaction, the evolved space relies on experience and perception as inputs to create the delight that the perceivers revel in. The framework of architectural delight can derive from any such parameters – an emotional state, a reaction, an idea or belief or even a sense of touch! Human experience is incomplete without a space, and architecture becomes a container of these experiences which, in turn, shape our association to the built space in which we exist.

NOTES

[1] Louis Kahn, "Order and Form", *Perspecta,* Vol. 3 (1955): 46-63, accessed January, 25, 2011, http://www.jstor.org/stable/1566835.

[2] Juhani Pallasamaa, *The Embodied Image: Imagination and Imagery in Architecture* (UK: John Wiley and Sons Ltd. Publications, 2011), 14.

[3] Ibid.,15.

[4] Quotefancy, "quotefancy-7wallpapers", June 02, 2019, https://quotefancy.com/quote/1611802/David-Chipperfield-There-is-a-danger-when-every-building-has-to-look-spectacular-to-look

[5] Neil Leach, *The Anaesthetics of Architecture* (Cambridge: The MIT Press, 1999), viii.

[6] Ibid.

[7] Chanel Dehond, "Easter Egg Hunt:Architecture Edition"*,* Archdaily (2019), accessed June 02, 2019, https://www.archdaily.com/tag/chanel-dehond.

[8] Ernst J Grube, *Architecture of the Islamic World: Its History and Social Meaning.,* ed. Goerge Michell (London: Thames and Hudson, 1995), 175.

[9] Christopher Alexander, *The Phenomenon of Life: The Nature of Order, Book-1* (Berkeley: Center for Environmental Structure, 2002), 439.

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Note - Student's Studio Work for Seasons' exercise referred in this paper is of First Year batch of 2015-16, 2016-17 and 2017-18 of VIT's P.V.P. College of Architecture, Pune

PRACTICE + THEORY: LESSONS IN EXPERIENTIAL LEARNING

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INTRODUCTION

"Learning is the process whereby knowledge is created through the transformation of experience."[1]
-David Kolb

Architecture by practice inherently involves both conceptual thinking and the physical manifestation of a built form. Students traditionally are fully immersed in the abstract thinking necessary for a design process but are less frequently afforded the opportunity to experience the act of building at full scale and interfacing with clients. It is precisely because architecture is a service industry charged with imagining and translating ideas into physical realities that experiential learning opportunities, where students are exposed to actual working environments and tools, are essential to our curriculum. The intention behind this approach is to establish a mindset of translating limitations into design explorations where students are encouraged to innovate, test, and investigate while considering the pragmatic parameters and constraints of real-world applications. By exposing students early in their career to these challenges, we can train them to be resourceful and inventive problem solvers and inherently promote proactive critical thinking and learning.

Historical Context

Experiential learning, in a variety of forms, has a long history in architectural education in the United States. Until approximately 1860 an architectural education was equated with having an apprenticeship with a practicing architect.[2] In the 1930's, Walter Gropius at Harvard's Graduate School of Design, influenced by the Bauhaus, emphasized training in construction and at the building site, and in the use of tools and materials.[3] In the 1960's architecture schools took on "a new position of community activism and social relevance,"[4] and introduced several new design-build programs, while in the 1990's design-build programs continued to grow "likely in response to theory-laden "paper architecture" and stylistic historicism of the 1980s."[5] Interest in design-build studios has only grown. In 2012 almost thirty schools in the United States and Canada offered such programs.[6] Many of the more well-known current design-build studios, such as the Rural Studio at Auburn University, or programs that partner with Habitat for Humanity, focus on the construction of actual buildings, and while exemplary, require a significant financial investment and sources of permanent funding are difficult to find and maintain.[7,8]

This paper will use two different student design-build exercises, led by faculty in the Department of Architectural Technology at City Tech, as case studies to discuss strategies for scaffolding and embedding small-scale experiential learning opportunities as part of required coursework. Although satisfying both aesthetic and performance criteria are requirements for most architectural and design-build projects, in typical design studios today the performative aspects of design problems are often secondary to aesthetic concerns. The small scale and rigorous constraints of the projects that will be discussed make it possible for the majority of the students to achieve both. Each covers aspects of client interaction, feasibility studies, budget, project management, material constraints, waste management, fabrication processes, performance, and detailing in addition to a collaborative design process and the construction of a physical product. Both projects utilize these constraints as assets that guide students' decision-making and help foster innovative design solutions. One project is a 20-foot-long furniture piece that accommodates multiple programs designed and built to be used within the department and the other is the design of an acoustic panel system for a local community organization. Taking cues from John Dewey's statement, "We do not learn from experience. We learn from reflecting on experience,"[9] the paper will reflect on lessons learned, student learning outcomes, logistics, applications for future projects, and, most importantly, how these opportunities connect the learning in the present to the experiences of the future.

The following section will unpack how these two projects were scaffolded and orchestrated in order to support the courses' learning objectives, and how they leverage experiential learning to expose the realities of the practice of architecture while promoting invention and innovation.

P01: THICK MEMBRANE

The exercise is a five-week module embedded in a fifth semester undergraduate design studio focused on the adaptation of interiors in urban environments. Driven by the need for seating, book storage, and a small workstation in the main office of the Department of Architectural Technology, the project emerged as design-build project for a 20-foot-long furniture piece that was to operate as a featured design object while accommodating the programs noted above. From a pedagogical stance, the module was applied as a device to focus students on pragmatic constraints as opportunities for innovation. Additionally, the design-build process and small-scale components of the exercise led class discourse to consider thoughtful material usage and thorough detailing while experiencing collaborative conditions, budget and scheduling limitations, and intimate interaction with digital fabrication processes and tools.

Project Execution Strategies

Prior to launching the exercise there was an extensive preparation process necessary to successfully execute the project. The first stage consisted of two parts. The first part was to develop a proposal that was presented to the administration for approval of the curriculum change, installation of the furniture piece, and access to equipment and a work area. Concurrently, the second part was focused on the acquisition of funding to hire a digital fabrication consultant and to purchase materials. This was ultimately accomplished through grants.

The next stage was to develop a series of directed assignments that would lead students through an analytical process that would inform the evolution and construction of the design proposal. It was also necessary to select a construction material early on in the project in order to meet scheduling constraints and structure the assignments. In this particular instance, ¾" maple plywood was selected because of its affordability, availability, and the fact that it could easily be milled on the CNC router.

The project was set up as a competition to help motivate the students. They were organized into groups of four. Each group developed and presented a proposal in an open review with the entire college community who voted for a scheme using anonymous paper ballots.

The assignment structure was divided into the following five categories:

- Analysis and Research
- Concept and Design Development
- Testing: Mockups and Prototypes
- Troubleshooting: Finding obstacles as design opportunities
- Build and Install

Analysis and Research

The first series of assignments focused on developing an analytical process to inform the design solution. Students addressed site, ergonomics, digital fabrication techniques, and material limitations.

A site analysis was devised as a strategy for understanding how the furniture piece would occupy the space. It should be noted, that in addition to analyzing and documenting space usage, circulation patterns, lighting conditions, site materials, and structure, as part of this process, students were required to document code and ADA regulations to be applied later in the design process.

The ergonomic analysis addressed the shape and movement of the body in order to accommodate specific functions. Ranges of motion and variations of scale were carefully measured and documented so that they could be applied as constraints when the design of the furniture piece was to be executed.

Lastly, the digital fabrication and material research component was introduced to help navigate discussions around the advantages, disadvantages, and properties of both the materials and fabrication tools to be used. Students were asked to study projects that have used similar approaches and technology in the past. Conversations about mass customization, precision, joinery methodologies, material structural limitations, sustainability, optimization of material usage, and budget constraints were had. To support these conversations, the fabrication consultants ran a series of workshops to familiarize the students with the process and tools they would be engaging.

Concept and Design Development

The next series of assignments addressed the thoughtful translation of the information collected during the research and analysis phase into design constraints. During the fabrication workshops many of the groups developed beautiful objects. The task at hand was to apply the constraints uncovered in the site and ergonomic analysis to control these objects and fulfill the programmatic requirements of the project brief. Achieving sophistication through iteration was at the core of this exercise.

Testing: Mockups and Prototypes

Once the students arrived a design proposal, each group selected a portion of the scheme to be fabricated and tested, first at a small scale and then at full scale. This was required to demonstrate that the piece was buildable, structurally stable, and would support the required program. Additionally, constructing at full-scale promoted the consideration of assembly, joinery, and detailing as design opportunities.
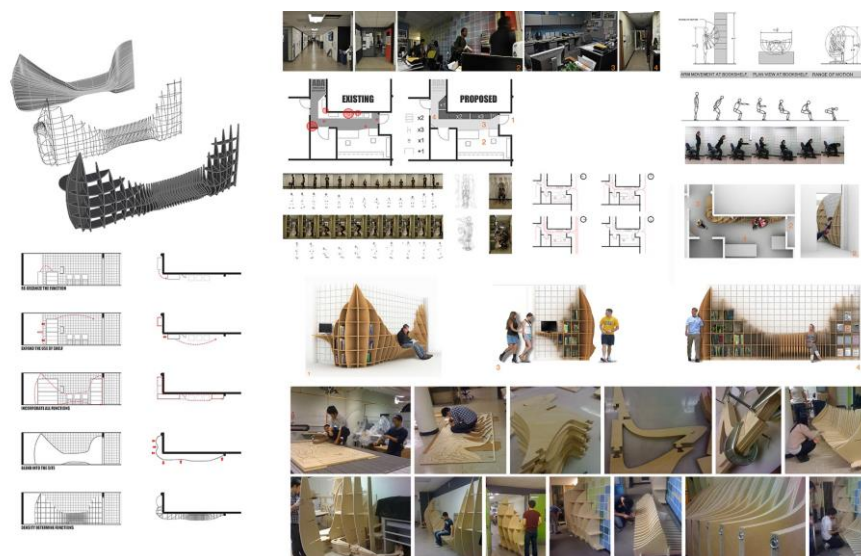
Figure 1. Example of Student Project Development

Troubleshooting: Finding obstacles as design opportunities

The full-scale mock-ups made evident that several aspects of the construction process were overlooked, and that many of the assumptions made in the digital world were inaccurate. It was exciting to see how the students navigated and calibrated their design solutions as a response to these obstacles. In one instance, for example, the use a wooden arch to support the seating area was proposed. In the mock-up it became evident that the arch was not structurally capable of supporting the load of three seated persons. A steel arch was considered as an alternative, but it was determined not to be a suitable solution due to budget limitations. Through many tests the students ultimately discovered a process of laminating layers of wood that was within budget, could structurally support the required load, and maintain the design concept.

At the end of the five-week module three alternate proposals were presented and voted on. We closed the project by initiating a discussion to help assess the value of experiential learning in the studio. The students were asked if there were aspects they found helpful or revealing about the process. Many of them expressed appreciation for the level of detail and design resolution that was achieved. They were surprised at how many things had to be considered in order to successfully execute a project. Collaboration was also discussed with many students expressing difficulty in managing personalities and assigning tasks especially during the design phase. They found this process challenging and, in many cases, had a direct impact on the development of the work. One of the conversations that seemed to resonate with many of the students was cost. It was revealing and surprising to them that even though the budget for the material was only $1,500, once we calculated overhead, design fees, consultant fees, and labor the project cost came close to $30,000.

Build and Install

The full construction and installation of the furniture piece was successfully completed on a volunteer basis over a six-month period. A group of six students who were particularly invested in the project, and wanted to further explore digital fabrication techniques, with the guidance of their studio professor, took on the challenge. In the process, they continued to apply the philosophy that every constraint is a design opportunity calibrating every detail and finally achieving a remarkable final product. The finished construct consists of over three hundred unique pieces that are seamlessly

assembled through joinery with no mechanical fasteners. Once assembled, the piece can be easily broken down into three separate sections for easy transport and reassembly. The final piece was presented at two different exhibitions and continues to be used on a daily basis in the department office.
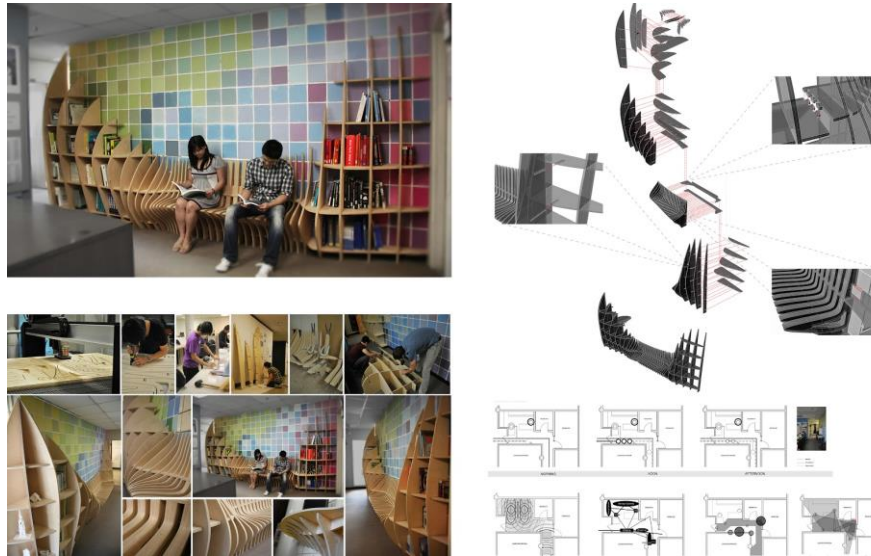

Figure 2. Final Construction and Installation

P02: BIOBAT

The genesis of the second project developed as a response to a need from a local non-profit organization, BioBAT. BioBAT is working with the New York City Economic Development Corporation (NYC EDC) to transform 500,000sf of raw industrial space at the Brooklyn Army Terminal into a science and technology hub. The architecture firm of one of this paper's authors had been working on a series of design interventions with BioBAT to help them establish a connection with the local community. In order to engage local residents with their new facility the client wanted to use their main lobby to host lectures and exhibits but given that the building is mainly comprised of exposed concrete surfaces, the poor acoustics in the space limited their ability to do so. The installation of an acoustic panel system was proposed to help attenuate the sound. Since BioBAT had shown interest in working on STEAM initiatives through their K-12 workforce development programs, we proposed that our City Tech students could become involved in proposing design solutions for their lobby. BioBAT was keen on establishing a new relationship with our college and we decided to implement the project the following semester.

**Project Objective and Approach**

The objective was to engage students in designing an acoustic panel system that would aesthetically represent the vision of BioBAT, improve the acoustics in the lobby, and to fabricate and present prototypes of possible design solutions. The initial challenge to this proposition was finding the right mechanism within the curriculum to execute the project and a team with the necessary skill sets. Implementing this project in a required design studio was considered but it would have required that all of the sections of the course adopt a similar project so that the learning objectives would be the same across all of the sections. The department decided to run the semester-long project as the focus of an advanced fabrication and computational design course. Additionally, we were fortunate to also have the support from an acoustician from ARUP who was willing to donate time to give the students

basic design parameters and provide critique throughout the semester. The course was selected for the project because it was an elective course that was already organized to provide students with the skills necessary for both designing the panel system and crafting physical prototypes.

For the project students worked in teams comprised of two or three students and a strict schedule of deliverables was maintained in order to meet the client's deadlines. Since the project necessitated a variety of skills such as design thinking, parametric modeling, construction detailing, the use of hand tools, CNC milling, 3D printing, and material research, working in teams allowed for the peer-to-peer exchange of knowledge and skills. Students were required to rigorously document their process and develop the appropriate graphics to present their solutions at a mid-semester review and final presentation with the consultant and client. Similar to the last project this exercise was organized into a series of assignments that included analysis, concept and design development, testing of materials and prototypes, troubleshooting, and constructing full-scale mockups. At each stage additional layers of constraints were folded into the project so that students could arrive at a final design solution that was visually appropriate while also performing acoustically and structurally.

Process

Students began the project by researching how sound travels and how it can be attenuated. With guidance from the acoustician, students used their research to explore possible forms for the panel assembly that could both perform acoustically and reflect the client's identity. Focusing on acoustic performance at this stage allowed students to see how performance criteria can help stimulate a design concept rather than being an impediment to the process. Many students used the form of sound waves as a point of departure for their designs but the forms quickly evolved once they also understood how to attenuate sound.
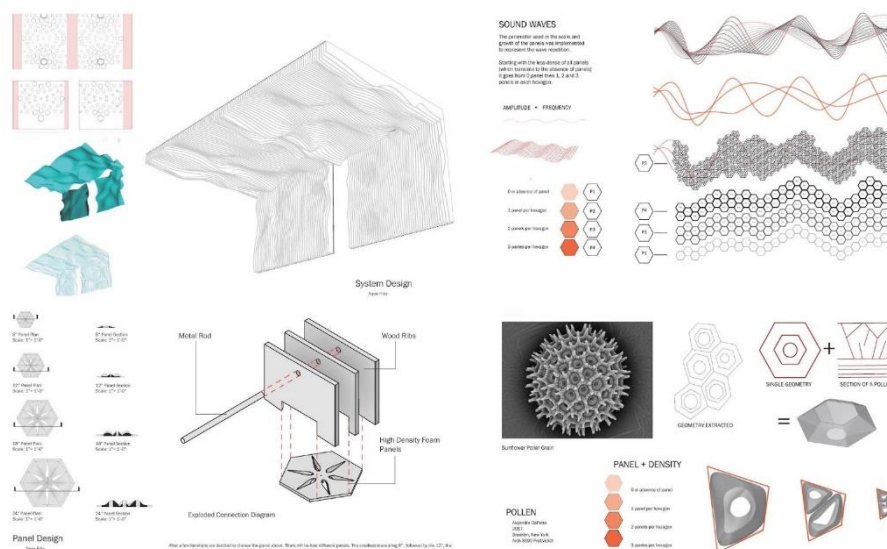
Figure 3. Example of Student Concept Board
Student: Alejandra DaPetta

Once they had a design concept, students had to research, evaluate and choose materials based on acoustic properties, light transmittance, structural loading, thermal expansion, and fabrication and assembly limitations. This research added additional layers of constraints that needed to be

considered. Students selected various materials to study and then designed and built small-scale mockups of composite panels consisting of at least three materials. They then tested and evaluated the panels for structural stability, acoustic performance, and aesthetics. Based on these results a composite panel was selected. The next assignment asked students to use both computer and physical modeling to design and test options for how to connect the panel to other panels and the ceiling and wall. They had to design these connections to function structurally while still maintaining their design intent. Once the overall design and details were refined students prepared final presentation drawings and built full-scale mockups of their proposals showing the composition of the panels and the required structural connections. Students presented their final design solutions to the client and other STEAM educators at an event hosted by BioBAT their facility.

In reflecting with students on their experience with this project they were most surprised at how much meeting performance criteria could affect how a design looks but moving forward they also could not imagine designing without these types of constraints. Providing specific criteria that needs to be met in a brief for a design problem, such as acoustic or structural performance, material constraints, or budget can help inspire innovative solutions and be the genesis for unexpected design directions.

Figure 4. Final Presentations at BioBAT

CONCLUSION

Teaching and learning to design for both aesthetics and performance is something that often gets overlooked in design courses but is crucial to the success of professionally built projects. Requiring students to equally engage aesthetic and performative concerns to create comprehensive design solutions will more adequately prepare them for their future in the profession. Still, we must acknowledge that there are many challenges to incorporating experiential learning in the classroom. There is a lot of preparation, coordination, and planning that is necessary prior to embarking on a design-build project that is often difficult to accomplish and finding opportunities for these types of projects can be hard to maintain. In the two projects discussed the scale of the projects was small in order to complete the majority of the project as part of the required coursework. The small scale also enabled an emphasis on constraints and performance criteria as primary design opportunities rather

than secondary concerns. The next stage of this research will be to develop a framework where students can apply similar methodologies at a larger scale.

NOTES

[1] David A. Kolb, Experiential Learning: Experience as the Source of Learning and Development. (Englewood Cliffs: Prentice-Hall, 1984), 38.

[2] Michael J. Lewis, "The Battle between Polytechnic and Beaux-Arts in the American University," in *Architecture School: Three Centuries of Educating Architects in North America*, ed. Joan Ockman and Rebecca Williamson (Cambridge: The MIT Press, 2012), 68.

[3] Joan Ockman, "Introduction-The Turn of Education," in *Architecture School: Three Centuries of Educating Architects in North America*, ed. Joan Ockman and Rebecca Williamson (Cambridge: The MIT Press, 2012), 21.

[4] Bruce Lonnman, "Constructing Design in the Studio: Projects That Include Making," *Rebuilding: Proceedings form the 98th ACSA Annual Meeting*. (2010): 68

[5] Vincent Canizaro, "Design-build in architectural education: Motivations, practices, challenges, successes and failures," *International Journal of Architectural Research*. (2012): 21.

[6] Richard W. Hayes, "Design/Build," in *Architecture School: Three Centuries of Educating Architects in North America*, ed. Joan Ockman and Rebecca Williamson (Cambridge: The MIT Press, 2012), 286.

[7] Bruce Lonnman, "Constructing Design in the Studio: Projects That Include Making," *Rebuilding: Proceedings form the 98th ACSA Annual Meeting*. (2010): 70.

[8] Hayes, 289.

[9] John Dewey. "How **we** think: A restatement of the relation of reflective thing in the educative process". (D.C. Heath, New York, NY 1983): 61.

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TOWARDS RE-SITUATING THE REUSE OF BUILDING MATERIALS: OFF-SITE REUSE IN ARCHITECTURAL PRACTICE AND EDUCATION

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INTRODUCTION

This paper interrogates the transformation of creative practices and educational concepts in relation to the built environment. It will discuss the innovative strategy of applying off-site material re-appropriation and re-use by analyzing two Rotor case studies. Two projects by Rotor firstly an exhibition 'Usus/Usures' presented in 2010 at the Venice Biennale in Italy and second a Workshop on Off-site Reuse titled "*Deconstruction*" taught in 2017 in cooperation with the Department of Architecture and the Built Environment at the TU Delft, Netherland will be discussed in order to explore the nature of Rotor's practice critique with regards to the reusability of off-site materials.

Off-site re-use in architecture is a practice that entails the process of salvaging components and materials from buildings that have reached their end-of-life cycle and then putting these "waste" material to use in a different situation or application. Off-site re-use as a design approach is not commonly applied in the education and practice of architects. The works of Rotor presents a welcome exception to this neglect. Based in Brussels, Belgium, Rotor is an emerging architectural practice in which various disciplines (from research and exhibition-making to material studies and reuse strategies) are combined to serve the off-site reuse purposes.

TOWARDS THE REDDEFINITION OF MATERIALS, MATERIAL PRACTICES AND SOCIAL RELATIONS IN ARCHITECTURE

Rotor's body of work seeks to advocate a new and different understanding of the role of the architect in terms of the way that materials are utilized or set aside or reused in the building profession. In the envisaged new role, the architect does not have to passively accept the traditional or conventional use and waste of material. Rather, the architect could be critical and constructive role in the proactive selection and procurement of utilized material and the architect can act as a social catalyst against wastefulness of materials that could be perfectly recycled and re-used in the building or construction process.

To consider material practices is not only to be interested in the techniques of making things; it is also to understand "things"—be they chairs, buildings or entire cities—as socially constructed and situated artifacts. This approach demands that a number of important questions be posed, such as: how have

these "things" been produced and by whom have they been produced or made? What kind of knowledge or information do these "things" display or convey?

From the nature of the material and their production or fabrication process, what could we learn about the users of the "things" and different uses for which these "things" have been made?

Materials are essential to this new Rotor paradigm on material and their applications. Indeed, the role that material-selection play in the crafting of buildings and the environment is no less significant than that of architects and designers. The Rotor perspective suggests that we should pay careful attention not only to their aesthetic aspects but also their sociocultural and environmental dimensions. Rotor seeks to understand the connection of materials to socio-economic processes and relationships and these material trace connections, from sourcing to eventual use, hold and offer illuminative socio-economic and political information.

From the Rotor perspective, creative practices should operate in an arena that is shaped by the functionalities and aesthetics of the material as well as by socio-economic and cultural considerations of the material. The point is that materials and material practices such as materials and construction are connected to non-material social dimensions or considerations. For example, we usually assume that gypsum board (used as wall and ceiling finish) is a universally standardized and neutral material. But as Rotor reminds us, gypsum today is primarily a byproduct of the energy production process. Sulfur-dioxide gas is generated as a byproduct of coal- and oil-burning industrial processes that largely contribute to acid rain. Hence it has become a common industrial and environmental practice to mitigate and wash out the harmful sulfur-dioxide gas with calcium-oxide and through this process gypsum is produced. Thus, in choosing to use gypsum as a building material or input, it would be helpful to be aware of these social connections and social positive externalities of the material.[1]

The works of Rotor explore the notion of wear-and-tear as it relates to the use of materials, objects and building structures. For the Rotor perspective, material-use is not to be conflated with or limited to program or function, but rather expanded to include the social aspects of the occupation and inhabitation or use of architecture products during their life span. Rotor focuses on modernist and contemporary buildings slated for demolition in order to re-use their material or "waste" components for innovative redesign.[2]

The Rotor preoccupation with off-site re-use is intended to question the standard use of demolition as a way to create a tabula rasa for new building projects. Rotor seeks to save condemned or "waste" materials while introducing a conservational social perspective into the architectural design process. The Rotor architectural practice entails building resources and their re-use in ways that challenge the historical and cultural conceptualization of buildings as well as their heritage and social value.

Material reuse encourages the consideration of buildings as cultural repositories, not just of their material essence but also of the knowledge and past practices of crafting buildings. These past building practices are also given as raw material—in this case, of the knowledge and skill—that might find new applications and contribute to new value systems. It is helpful to a reassessment of our conventional understanding of our architectural heritage by considering buildings as an assemblage of elements that could be dismantled and later reassembled, possibly into totally new configurations or possibilities.

REUSABILITY, SUSTAINABILITY OF THE BUILT ENVIRONMENT AS PART OF AN EDUCATIONAL PROJECT

In the coming years, the reuse of components of existing buildings will become of more and more importance. The construction industry consumes raw materials in considerable quantities and produces an enormous mass of waste. Rotor's design approach addresses reusability and sustainability as part of

a sociopolitical project. It critiques the modern throw-away consumer culture and highlights how product-outsourcing to global supply chains conceals poor labor conditions that result in the depoliticization of working conditions and environmental costs.

To counter this wastefulness, Rotor has developed guidelines, protocols and regulatory frameworks for the reclamation of reusable materials and the integration of "waste" into the current building processes.[3] In 2015, Rotor developed a handbook for off-site reuse in Belgium: a model of legal and practical guidelines for the reclamation of reusable materials from public buildings.[4] They are also advocating for regulatory policies within the European market that will re-introduce salvaged building material into the building construction process. Rotor hopes to contribute to the re-evaluation, re-design and re-usability of the building-materials economy.

CASE STUDY 1: USUS/USURES – THE ARCHITECTURE EXHIBITION AN EDUCATIONAL ENVIRONMENT FOR REUSE STRATEGIES

The work of Rotor represents a new kind of emerging multi-disciplinary practice in architecture: from research and exhibition-making to material studies and reuse strategies. Rotor is interested in material flows in industry and construction, particularly in relation to resources (waste, use and reuse) that challenge historical conceptualization of building culture, heritage and social value. They deconstruct buildings into elements (construction, materials) and reassemble them in new ways. This is an approach about material and knowledge of past practices of crafting buildings and interiors. They aim for both new applications and new value systems around materials and their assembling. Rotor undermines the conventional professional divisions of responsibilities between clients, contractors, workers, designers, users and other stakeholders.

Rotor's distinct interdisciplinary approach could be described as deconstruction, relocation and assemblage. This distinct interdisciplinary approach of Rotor – which can be described as deconstruction, relocation and assemblage – has been at the center of their exhibition Usus/Usures for the Belgian Pavilion at the Venice Biennale in 2010. At the international architecture exhibition, they displayed mundane materials and products salvaged from Belgian social housing projects as abstract art.

The selection and framing of used materials and architectural elements of a social housing complex is not a purely aesthetic or neutral act, but points to the growing problem of unavailable low-income housing in Belgium and other Western countries.

Usus/Usures was entirely made from salvaged building components that are usually overlooked and treated as 'waste' (deconstruction), such as carpet, stairs, railings, etc. These are then exhibited in a reassembled manner (assemblage) in the Belgian Pavilion at the Venice Biennale (relocation).

In the general architectural practice, the customary thinking about the utilization of building materials usually entails the design of 'new objects' and the procurement of novel materials specified and ordered from various product catalogs. With Rotor's new approach, however, there is an entirely different process in thinking of materials as something physical and tangible to be identified transported from one place to another and then reframed. Rotor's design practice deconstructs buildings into elements (construction, materials) and reassembles them in new ways by integrating existing components (from off-site reuse) into new structures.

A red carpet, for example, was taken from an apartment in a social housing block (relocation) and mounted on the wall of the exhibition as the apartment's floor plan (assemblage). The caption for this piece merely noted: "Acrylic fiber carpet in a living room adjacent to an entryway, a hallway, a bedroom and a kitchen." The red industrial carpet is represented as a diagram of the wear and tear created by the occupants through the processes of habit and inhabitation. Thus, this carpet, already

condemned as "waste" becomes a kind of manual for re-use and instead of being a deficiency, the traces of wear-and-tear lead to critical reflections on use, users and construction practices through the new context of the art exhibition.

In a similar fashion, an extracted banal industrial staircase shown in the Belgian Pavilion could be read as a map of human movements walking up and down this stair. These works create an understanding of the human body as a formative tool that leaves distinct material traces of everyday human activity.

The building components were exhibited in an isolated manner so as to draw closer attention to their own intrinsic qualities— despite or perhaps because of their anonymous and ordinary appearance. Though minimalist in appearance, the Usus/Usures exhibition resulted from Rotor's extended research on material wear-and-tear as well as the re-usability of buildings and building materials.

Rotor's intention for Usus/Usures "was to bring the subject of materiality into the arena of the Venice Biennale opposing the glorification of 'the New' that is implicit in this kind of exhibition format." They intended the subject of wear-and-tear to draw attention to the reaction of buildings to longtime use while challenging architects to critically anticipate this depreciating process. Thus, looking at buildings through the wear-and-tear lens leads to reflections on use, users, and construction practices. The educational intention of an exhibition such as Usus/Usures is that Rotor encourages the public to change their attitude towards building materials, and more broadly towards all objects around us.[5]

The discussion of wear-and-tear is largely taboo in architectural circles partly because it contrasts fundamentally with the value of purgation as well as with construction cycles that have become shorter and shorter. As Rotor notes: "in the 20th century, under the combined influence of increased real-estate pressure, an obsession for speed in demolition, the availability of power- machines and explosives and fiscal constructions had encouraged accelerated building obsolescence."[6]

CASE STUDY 2: STUDIO ROTOR: DECONSTRUCTION: OFF-SITE REUSE IN ARCHITECTURE PRACTICE AND EDUCATION

The Faculty of Architecture and the Built Environment at the Technical University Delft in the Netherlands in 2017 offered a master studio and symposium titled, *"Deconstruction: Off-site Reuse in Architecture."* This symposium was taught in cooperation with the Rotor group. In this collaboration with the Technical University, Rotor's intention was to expose young architects and architectural students to the notion of deconstruction and building components reuse.[7]

The core element of Rotor's master studio at the Technical University was the focus on deconstruction studies of one contemporary building as well as two modernist buildings that were already slated for demolition. Rotor then took the initiative to get the permissions necessary to make the "waste" components of the demolished buildings available for new, innovative redesign and reuse assignments.

The Rotor studio was structured around 3 different exercises involving 3 actual buildings (one contemporary building as well as two modernist buildings). These three cases were investigated in order to explore the possibilities and limits of the re-use of "waste" building materials. The studio followed the format of an intensive 10-week workshop program that combined archival research, building analysis, site visits, and total redesign.

Building 1: Revaluation of the Timmerhuis Building in Rotterdam

The first case was focused on the Timmerhuis Building in Rotterdam built from 2013-2015 by the Office for Metropolitan Architecture (OMA) in Rotterdam. In the designed and construction of this multifunctional complex, the structural and functional intentions were to achieve maximum modular flexibility while allowing for the future re-use of the building's old components.

The Timmerhuis was constructed as a cellular and flexible structural system that would allow units to be added or 'dismounted'. This modular system adopted as a deliberate strategy to counter and mitigate obsolescence by endowing the building with the capacity to adapt over the course of time to programmatic changes and new spatial demands.

The task of the studio was to assess the re-use value of the components of the Timmerhuis building through both a cost-structure and a carbon-dioxide analyses of the building's structure, mechanical systems, facade, and interior finishes. Estimating the re-use value of a given building component depended on a number of factors, including: the existence of actual demand for the element; ease of dismantling; the weight; the number of units or elements available; and the time required for disassembling the unit(s).

The students had to produce a schematic simulation or visualization of the building and its components and contents in order to be able ascertain the value of per kilogram per component. The easiest components to re-use were those that hold the most value and that are the easiest to dismantle. Incidentally, the weight or lightness of a component usually indicated ease of dismantlement. The students used a color-coding scheme to provide information about every building component and to indicate the price per kilo that had been spent on the component. For example, Petra Blaisse's curtains and carpets were shaded in a dark orange tone that denoted their high re-use value. Some of the building's interior furnishings were the work of renowned designers and therefore valuable reuse items.

Building 2: Redesigning a dismantled Youth Hostel in Ockenburgh

The second case-study building was a Youth Hostel in Ockenburgh that was built by Frank van Klingeren in 1974. The building became vacant in 1997 and, shortly thereafter, the Dutch municipality of The Hague began to plan for its transformation into a conference hotel. Eventually in 2007, the prospect of the building's demolition was mooted, because the building could not functionally and aesthetically "be satisfactorily integrated into" the new use requirements for the youth hostel. The building's steel frame and structure were dismantled and stored in 2010.

In this studio exercise, the students' design proposals made use of the available steel components from the dismantled youth-hostel building. The students visited the site where the steel pieces were stored and made an inventory of the components that were to be reused in the design of a series of pavilions to be located on the same site. The student projects were encouraged to use all available stored components of the original building.
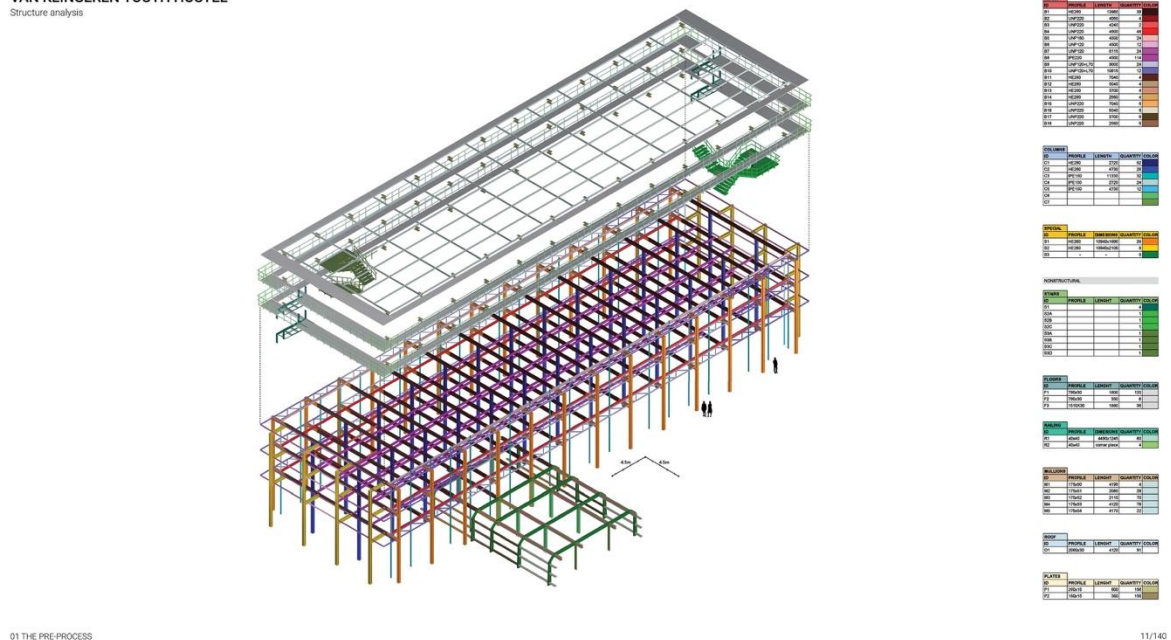
Figure 1. Structure Analysis of the Frank van Klingeren Youth Hostel in Ockenburgh as part of the Deconstruction Workshop by Rotor in Delft, a collaboration between TU Delft, Het Nieuwe Instituut and the Jaap Bakema Study Centre, 2017

Building 3: Reusing the Ministry of Social Affairs in The Hague

The third and last case study in the studio was the building that housed the former Dutch Ministry of Social Affairs in The Hague. Herman Hertzberger was commissioned to design the building in 1979 and the building project was inaugurated in 1990. The building ranks as one of the last major achievements of Dutch Structuralism. The students also produced a schematic simulation or visualization of the building and its components and contents in order to be able ascertain the salvage utility or reuse value of building components.

Gathering information from the Hertzberger design archive and from site visits, the students developed a quantitative analysis of the demolition and an assessment of those building components that could be salvaged for off-site reuse in an economically plausible manner. The students undertook a detailed description and inventory of building components that could be salvaged, including prefabricated concrete structural elements; ceilings and lighting fixtures; various pieces of technical equipment; glass; window profiles; steel frames; doors and partition walls; as well as signage and art works.

This inventory process was followed by the dismantling of representative samples of the building materials. The finale of the studio process was an exhibition of the selected components showcased by the students in the public halls of the Ministry of Social Affairs in The Hague.

This final Workshop exhibition was staged as a contemporary archaeological site, with the samples arranged in a new compositional order while the design work by the students showed its potential for reuse and reinterpretation.

The deconstruction process entails the operation of taking a building apart entirely or partially so that the salvageable or reusable components could be deployed or utilized elsewhere. This kind of deconstruction and redeployment has been done since the earliest times in the evolution of human civilization. Apparently, the stones that composed Stonehenge[8] were reported to have been part of an earlier structure. In the Middle Ages as well as during the Renaissance and in the 19th century, such materials redeployment and reuse was common practice.

Today, we seem to have lost the practice or habit for such material redeployment and re-use mainly because the building industry has become highly dependent on industrially produced building materials with extremely precise and detailed performance metrics. When it comes to salvaged building components, however, it may not be so easy to achieve this kind of precise and detailed performance projections. But this issue of quantifying the performance metrics of salvaged building materials is not one that cannot be resolved or accommodated.

Therefore, it is important for practicing architects and architecture students to be aware of these attendant issues and the economic cost-benefit analyses involved in the deployment of salvaged and reused building materials. Students and practitioners of architecture should be helped to become conceptually and practically aware of this more pragmatic approach of sustainable architecture and the building craft. We should think of buildings and what to do in their end-of-life cycles in terms of lessons to learned and subsequent values to be extracted therefrom.
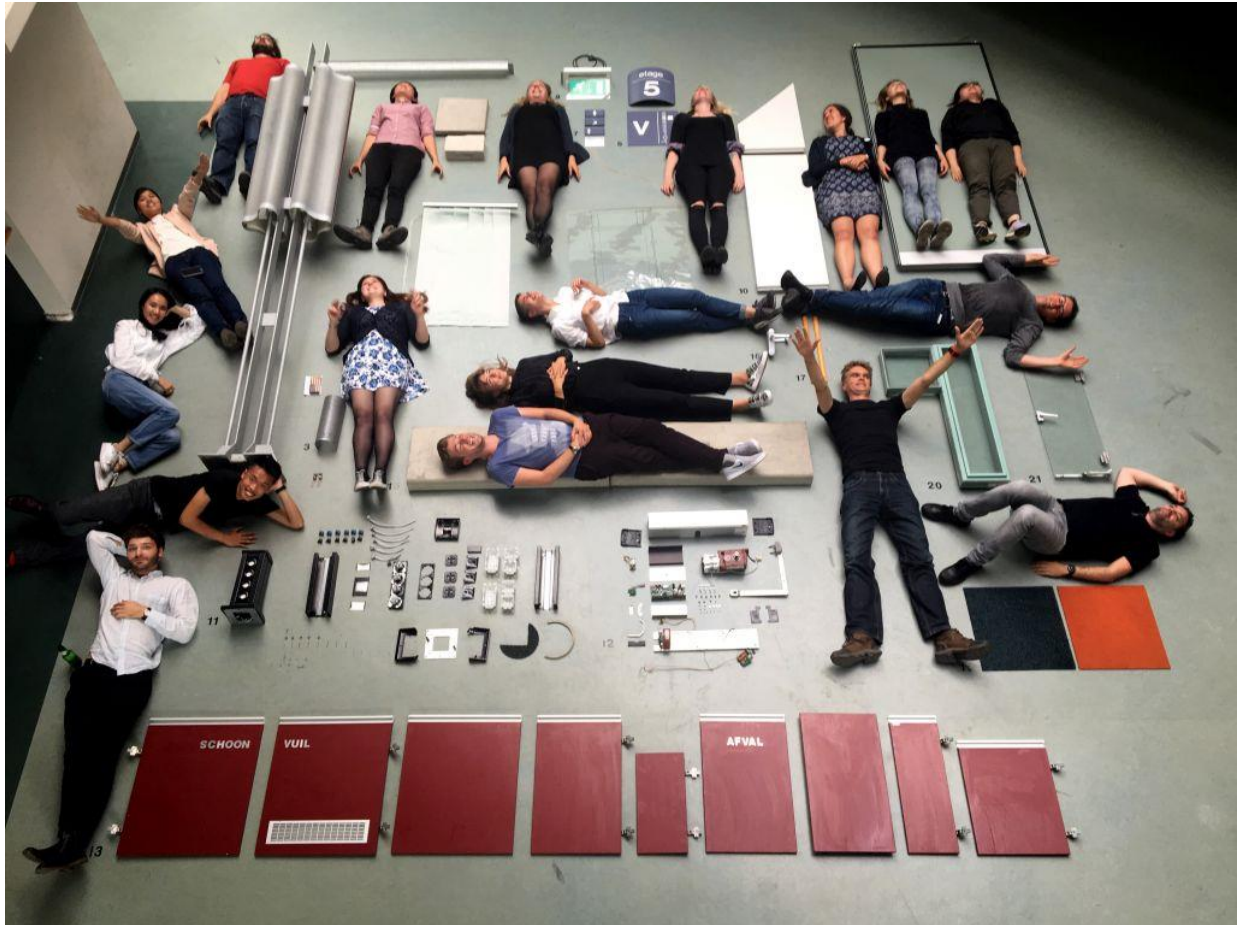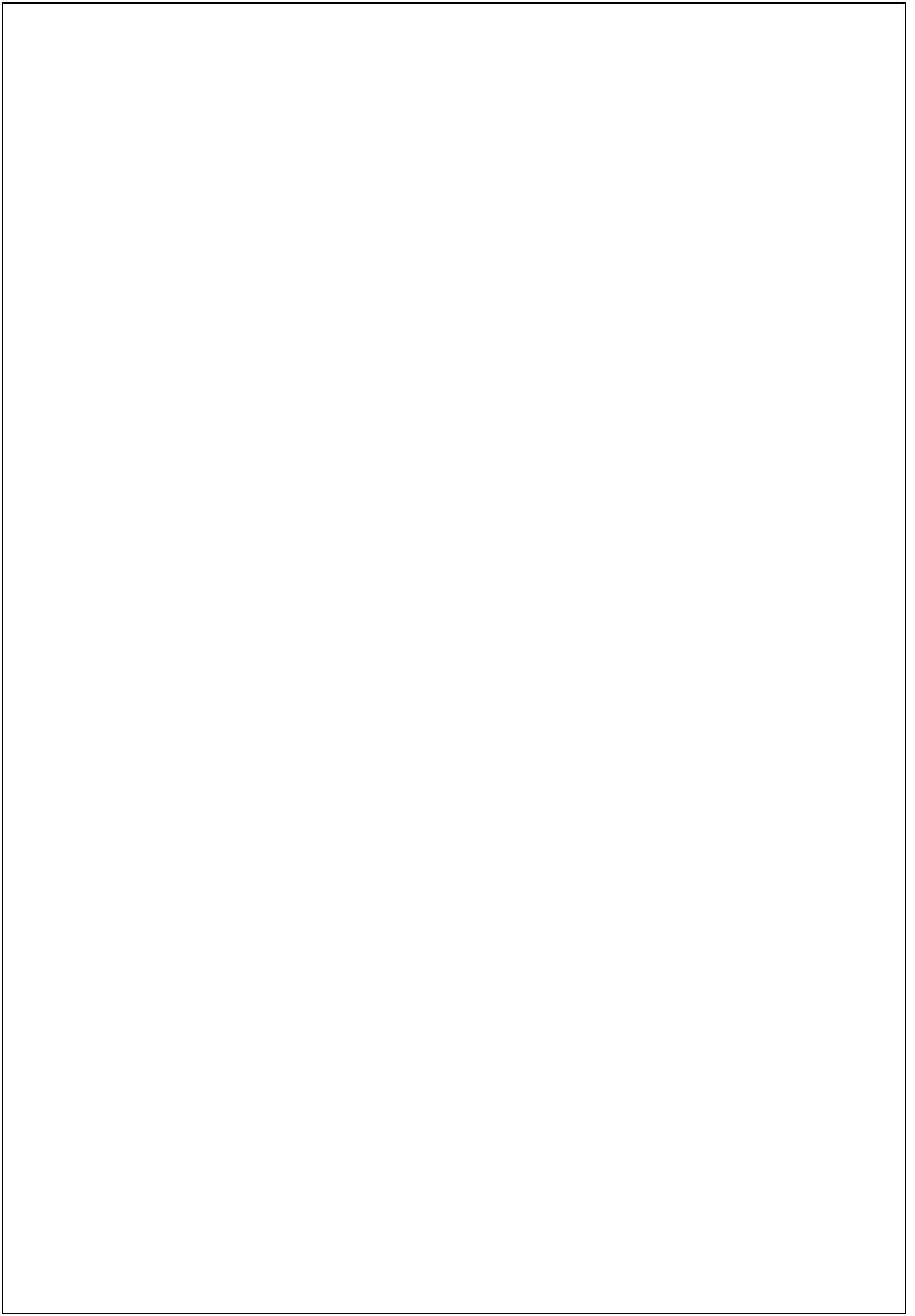
Figure 2. Foto by Anna Gunnink, Final Exhibition of the Deconstruction Workshop by Rotor in Delft, a collaboration between TU Delft, Het Nieuwe Instituut and the Jaap Bakema Study Centre, 2017

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