INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
10-11 SEPTEMBER 2020, VIA DESIGN, VIA UNIVERSITY COLLEGE, HERNING, DENMARK

AN ACTIVE LEARNING APPROACH FOR A DESIGN THINKING COURSE

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ABSTRACT
The paper presents the case of the course "Design Thinking and Processes", part of the curriculum of the Design and Engineering MSc of Politecnico di Milano. The course aims at stimulating critical reflection through the understanding of how design has evolved from its birth to nowadays. The paper focuses on the redesign of the theoretical course from traditional receptive structure to an innovative one, that heavily integrate active learning through seminars, flipped classrooms and group discussions. After three years of experimentation and refinement, the course appears to be coherently designed in terms of intended learning outcomes, assessment strategy, activities and contents. The overall course was assessed by students throughout the first semester of the current academic year. The paper aims at discussing the results of this assessment, offering to teachers and scholars an example of active learning approach to support students' learning and critical reflection in theoretical courses.

Keywords: Design thinking, active learning, design education

1 INTRODUCTION

The presented didactic experimentation refers to the teaching and learning of Design Thinking theory, within a first year Design & Engineering master, to foster alignment among students with different cultural and academic backgrounds. First, *Design thinking* is here considered from the academic perspective, referring to the consolidated forty-year discourse about non-verbal professional designer competence within classic design disciplines such as engineering and industrial design [1]. This debate, in which Cross [2][3][4] is one of the most prominent scholars, differs from the managerial discourse around design thinking, here intended as a generalised human-centred approach for businessmen and managers to problem solving through creativity [5].
Due to the extensive employment of design-based learning approach [6] in design education, students are often exposed to "learning by doing". Indeed, within design studios and workshops, students are frequently acquiring the skills needed to think and act as professional designers, being engaged in design projects. Throughout these courses they learn the current way in which designers think, which is the result of a century of disciplinary developments due to societal and technological changes [7].
As much as *current design practice*, also *future design practice* can be different according to unpredictable forthcoming socio-technical variations (there is no better example of this than the recent spread of COVID-19). It is therefore our belief that a Design Thinking course is relevant if it serves students to develop a conscious and critical view of the reasons that have influenced *the designers' current way of thinking*. Therefore, our main assumption while structuring the courses' contents was that a student who can critically link the current state of design profession to the historical facts that shaped it, will be also able to get a deeper understanding of future societal and technological challenges. Historical notions on how design practice evolved provides students with a solid ground for developing critical thinking and, at the same time, ensures alignment among students that do not have a homogeneous undergraduate training (e.g. international students both from design and engineering backgrounds). Therefore, our Design Thinking course should as well foster alignment among culturally diverse students on *how design practice evolved* and on *how designers are expected to think*.
As formulated, our main assumption does not entail any change to teaching modalities, meaning that the course could still be largely based on the traditional receptive architecture that assumes that "learners can absorb knowledge and skills when they are exposed to them, such as when listening to a lecture, watching a video, or reading text" [8]. After organising the course with a major receptive architecture for two years (in 2017 and 2018) we observed that students may encounter difficulties to link the

theoretical knowledge provided with the practice-based knowledge acquired in the majority of other courses (i.e. design studios, workshops). We therefore decided to refine the course architecture, rather than the contents, integrating a more active teaching and learning approach to stimulate students' critical understanding of Design Thinking.

2 REDESIGNING OF THE COURSE

As said, after identifying the students' difficulties to connect the provided theoretical notions to design practice, we decided to redesign the course "Design Thinking and Processes", part of the curriculum of the Design and Engineering MSc of Politecnico di Milano. In doing this, we followed the didactic theory of constructive alignment by Biggs [9], assuming that teachers can effectively guide students in their learning by structuring a coherent link between the intended learning outcomes (ILOs), the teaching/learning activities (TLAs) and assessment [9].

The course took place one morning per week during the first semester of the current academic year. The class was composed by around a hundred of students. To test the new course version, we used action research which is widely employed in didactic as *"an inquiry conducted by educators in their own settings in order to advance their practice and improve their students' learning"* [10]. The ILOs of the course were outlined based on the assumption addressed in the introduction (see *Table 1*).

Table 1. ILOs of the course

	Descriptor	Educational Objectives
ILO 1	Students can present the key issues in the disciplinary history of Design, illustrating the correlations with the dominant socio-technical context.	Remembering Understanding
ILO 2	Students can analyse a specific product or design issue according to the related key issues in the disciplinary history of Design.	Applying Analysing
ILO3	Thanks to the conceptual tools provided, students can critically support a thesis related to current design practice.	Evaluating Creating

The selection of the TLAs was a crucial part of the course redesign. The course contents were structured through an extensive literature review, organised and published in a book by Rampino [7]. The book presents four main perspectives in western product design, namely the Technical, the Human, the Digital and the Social Perspective. Being these perspectives the result of the combined effect of economic, socio-cultural, technological, and environmental changing realities, each of them has seen the rise of certain design discourses and the development of specific design skills, methods and processes. The textbook extensively discusses the way in which these changing realities influenced design thinking. Originally, the course included ex-cathedra presentations, guest lectures and seminars (see *Table 2*). In the course redesign, most ex-cathedra presentations were replaced by flipped classrooms to support active learning [11]. To help students critically connect the notions studied at home with current design practice, specific in-class activities were designed [11][12]. In *Table 2* all the proposed TLAs are described. Each TLA's percentage of time is calculated on the total amount of course's hours (48 hours).

Table 2. Time percentage dedicated to each TLA in the original course and in the redesign

TLA types	Description	Original course	Redesigned course
		% of dedicated time	
Ex cathedra presentations	The teacher orally presents the contents in class, students listen, take notes and ask questions.	52%	**17%**
Guest lectures	Guest lecturer, academics or practitioners, are invited during class and they deepen a specific topic related to the contents. Students listen, take notes and ask questions.	25%	**21%**
Flipped classrooms	Students are required to prepare for the lesson in advance, reading the assigned book's chapters. During class, contents are briefly recalled by the teacher. Then, students are engaged with exercises, discussion-based activities, and team-based learning.	0%	**29%**
Seminars	Students, gathered into small groups, research at home about a specific issue and critically build an argument to defend their thesis. The result of the study is orally presented to the whole class.	17%	**17%**
Other activities	Activities dedicated to verifying student's learning or to provide space for feedbacks (described in the following subparagraphs).	6%	**17%**

Compared to the course original version, the time dedicated to "other activities" is around three times as much (17% over 6%). Most of this added time is devoted to verifying student's learning.
In the original course, the assessment was carried out through a final questionnaire and through the evaluation of seminar's presentations. In the course redesign, at the end of each flipped classroom, students answered to four open questions intended to test their understanding of the contents and, at the same time, their ability to link theoretical contents to in-class activities (e.g. case studies, group discussions). The total weight of questionnaires on the final grade is 76%. The remaining percentage of the final grade is obtained through a final test (11%) and the seminar's presentation (13%).
In table 3 all the assessment strategies are reported and related to the 3 course's ILOs.

Table 3. Assessment strategies applied in the course and weight on the final grade

ILOs assessed	Assessment strategy	Weight on the final grade
ILO1, ILO2	Four individual questionnaires with open questions about the contents and with reference to the in-class activities.	19% each (76% total)
ILO2, ILO3	Case study analysis based on the four Design Thinking perspectives (final test)	11%
ILO3	In class group presentation during the seminar, evaluation based on the group capacity to be clear and effective in sustaining their argument and to be "innovative" in proving their thesis.	13%

3 METHODS

Data has been collected through a mixed methods approach, focusing exclusively on attending students. Quantitative data, such as number of attendants and their grades, have been compared to the two previous years. Grades are an important indicator of students' critical thinking abilities because they consider students ability to rework the concepts presented during the course and to critically link them to the design practice.
Qualitative data have been collected through the evaluation questionnaire, voluntarily completed by 48 attendants at the end of the course. Students provided opinions about the learning experience and the integration of active learning activities in a theoretical course. The questionnaire contained the following open-ended questions: 1) What have you learned in this course?; 2) Compared to a "traditional" (receptive) course, which have been the advantages?; 3) What can be improved next year?
Answers have been analysed and translated into a series of keywords that have been clustered into categories as seen in this example.

> *"This course taught me how design has evolved based on the requirements and necessities of the society, of the industry and of the user. I have also been enlightened about the considerations that need to be validated in the process of designing objects" (Student 43)*

This answer, for instance, had been interpreted with the keywords "design history", "design perspectives" and "applied design knowledge". Keywords and categories contribute to results articulation; the data are reported, represented and discussed in the next section.

4 RESULTS AND DISCUSSION

It must be noted that the presented results are based on the attendants' evaluation of their learning experience, with a specific focus on the newly proposed active learning approach. The students' own evaluation was enriched by data gathered through participant observation conducted simultaneously by the two authors during in-class activities.

4.1 Attendants and grades

The percentage of students attending to the number of students enrolled is similar in all the course's editions (*Table 4*). This is remarkable since students decided to take this path after being informed of the high commitment it required in comparison with previous years.

Table 4. Numbers of students enrolled, attendants and non-attendants

	2017	**2018**	**2019**
Students enrolled	121	115 students	113 students

Attending students	89 attendants (73,6%)	78 attendants (67,8%)	83 attendants (73,5%)
Non-attending students	32 non-attendants (26,4%)	37 non-attendants (32,2%)	30 non-attendants (26,5%)

Through participant observation, we perceived that students displayed a better understanding of contents during debates and in their tests, perception that is partially reflected in the final assessments of attending students (Figure 1). The 8% of attendants was graded with honours (compared to the 3% in 2018 and 2017) and the 23% were graded between 30 and 29 (compared to 15% in 2018 and 26% in 2017). The curve is slightly shifted towards higher grades but is not significantly increased. On the other hand, our perception found stronger confirmation in the analysis of seminars evaluation, which registered a sensible increase in "A" percentage (51% in 2019, 40% in 2018, 37% in 2017).

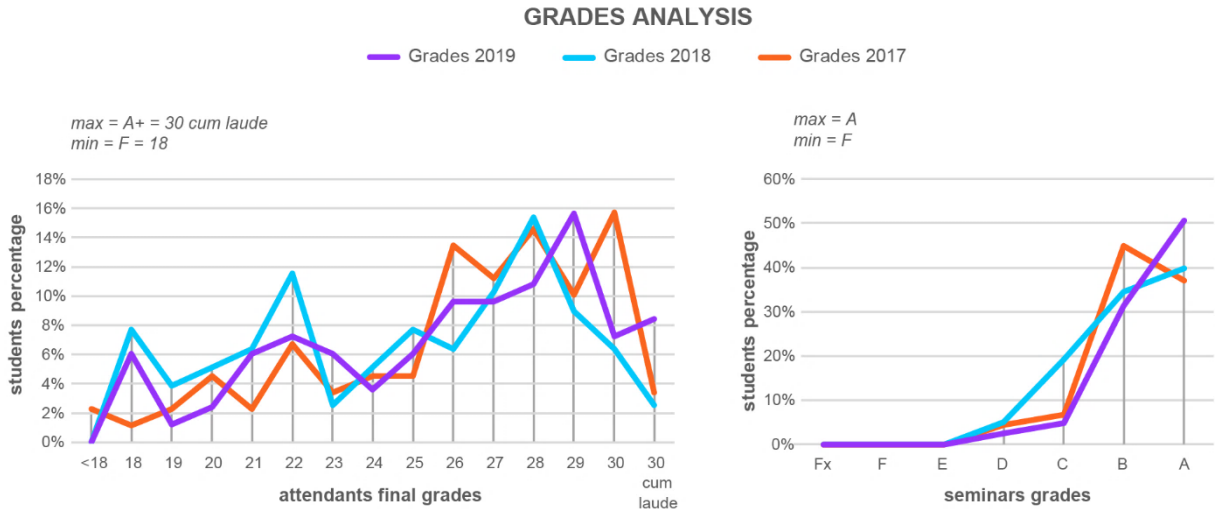

Figure 1. Grades analysis

4.2 Feedback session and course evaluation questionnaire

The 58% of attending students (48 out of 83) actively approached to the feedback session, participating to the group discussion and filling in the open-ended questionnaire. In Figure 2, 3 and 4 the analysed data are represented. On the left there is the list of the keywords extracted from the students' answers and on the right the categories in which the keywords have been clustered; the edges between the two of them are sized according to the recurrence of each keyword.

Answering to the first question *(what have you learned in this course?)*, 34 times students mentioned contents related to design practice, which have been collected in the category "applied design knowledge".

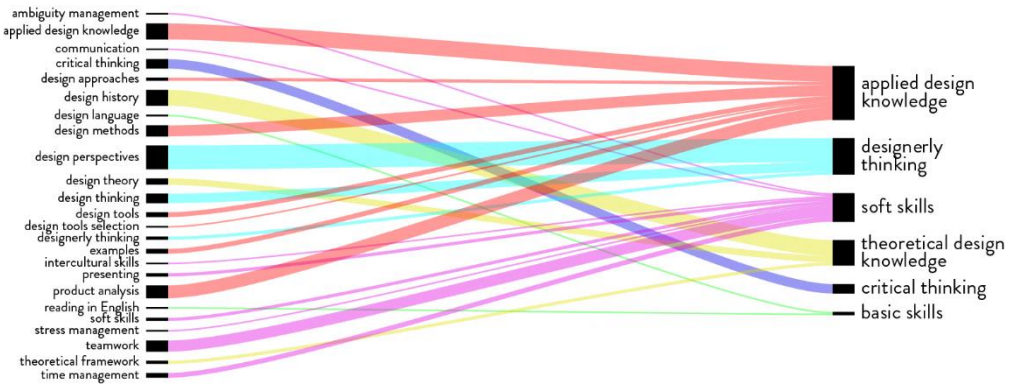

Figure 2. Analysis of answers to the question "What have you learned in this course?"

Other recurrent learning outcomes, identified by students, relate to the categories "designerly thinking" (23 mentions), "soft skills" (18 mentions) and "theoretical design knowledge" (16 mentions). As "critical thinking" is strictly related to the focus of this study, a special attention was put to the direct

mention of this keyword which constitute a category by itself. Even if it is not one of the most cited as a category, it is in the top ten of recurrent keywords.
Analysing the answers to the second question *(compared to a "traditional" (receptive) course, which have been the advantages?)* it was useful to introduce subcategories to better organise keywords (see Figure 3). It emerged that students recognised as an added value the overarching organisation of the new course (42 mentions). Also, 36 times students referred to active, collaborative and deep learning as advantages of the course compared to a receptive one. These elements have been clustered as "learning styles". Students also cited engagement and *fun*, grouped as "students' feelings and motivation", as a positive aspect of the course during in-class activities.

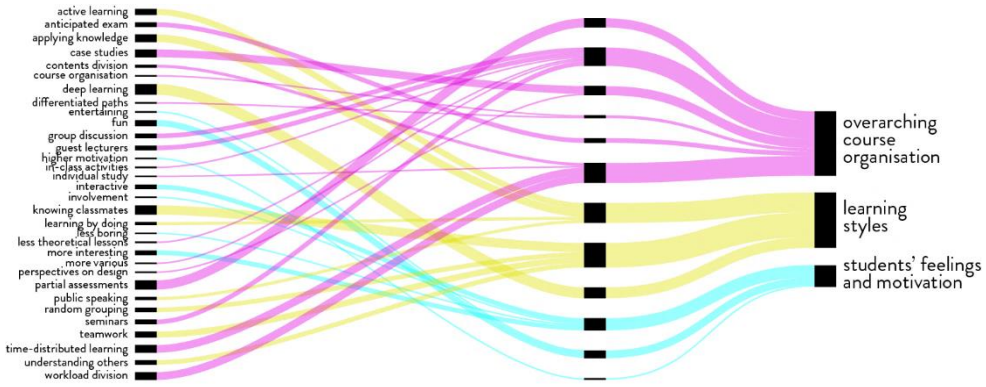

Figure 3. Analysis of answers to the question "Compared to a "traditional" (receptive) course, which have been the advantages?"

In the last question *(what can be improved next year?)* students provided suggestions on elements to improve. The majority of comments highlighted the need to refine the TLAs (33 mentions), among which several students pointed out the willingness to improve active learning in some activities they judged as passive (i.e. more class debate, more active seminars, interaction in class). The category "assessment strategy" emerges as an element to be enhanced (20 mentions), where a higher consideration of active learning activities appears to be a priority.

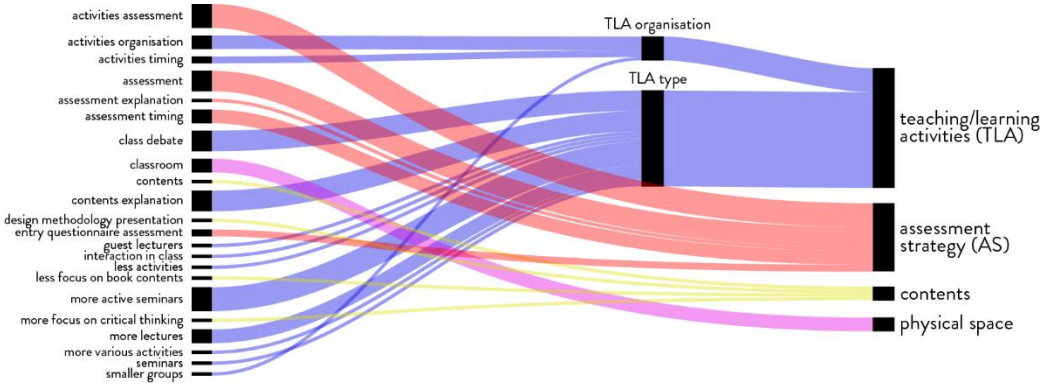

Figure 4. Analysis of answers to the question "What can be improved next year?"

4.3 Discussion

In general terms, empirical evidences revealed that the redesign of the course, with its active learning approach, effectively improved students' ability to connect the theoretical contents of the course to design practice improving their critical thinking, motivation and therefore enhancing their learning experience. This results' interpretation is supported both by the quantitative and qualitative data collected. Indeed, the number of attendant students remained like the previous years, even though the redesign of the course required more time and effort from students. For higher education systems where attendance is not mandatory, like ours, this suggest that a more demanding course does not necessarily impact negatively on students' attendance. In parallel, a slight increase in the attendants' final grades and a noticeable increase in seminars' grades can be noted. Seminars represent the only activity that remained unchanged from the receptive version of the course, permitting a direct comparison with

previous years' grades. Seminars' grades and observations suggest that the ability to critically argument a given controversial thesis was more developed in the redesigned course version.
Concerning qualitative feedbacks, some students explicitly declared to have learned critical thinking and some others referred to the application of theoretical concepts to design practice. Therefore, from students' words, it emerges that the course stimulated a critical reflection on Design Thinking, giving them competences for bridging theoretical knowledge to an applied one. Also, they explicitly pointed out to prefer the active learning approach to stimulate a deeper understanding of contents. Moreover, this type of learning was evaluated as more motivating than traditional theoretical courses. Finally, from students' suggestions for improvements, it emerged that an even more active approach in some activities would have been appreciated. Besides, many proposed to include as part of the final course assessment the results of the in-class activities, demonstrating that students recognise active TLAs as a relevant part of their learning path.

5 CONCLUSIONS

The paper presents the redesign of the course Design Thinking with a more active teaching and learning approach. Both the attendants' assessment and students' qualitative feedbacks about the course show that active learning stimulated the critical understanding of theoretical notions, allowing a deeper learning experience. Most students stated that the revised course helped them to link design thinking theory to design practice, providing evidence that the courses ILOs have been achieved. Moreover, students suggested to improve the course introducing other active elements, proving that debate and discussion were perceived as an effective activity to foster their learning.
The overarching course organisation has been evaluated as the main advantage of the course compared to a traditional receptive theoretical course. Besides, it is noteworthy that students recognised learning style and motivation as impactful advantages; future experimentation should address ways to robustly leverage these components. The course still needs to be refined for what concern assessment strategy, which appears to be a weak point especially regarding the active TLAs. Due to their importance in terms of ILOs achievement, active TLAs should be more effectively considered in student's assessment, becoming a consistent part of the final grade.

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