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Abstract. Global challenges, such as Climate Change and Sustainable Development, require the design of sustainable lifestyles, products, services, and cities that reduce carbon intensity by at least 50% before the year 2030 and 100% by the year 2050 to avoid long-term climate catastrophes.

Short-term action is needed to accomplish long-term sustainability goals. We work on the 2030 deadline with every tool available to us: new course development combined with new pedagogy to effectively and efficiently deliver time-based design. We made our courses available online as open source resources within a global network of universities.

In this paper, we describe a project called “Dexign Futures” initially developed at the School of Design at Carnegie Mellon University. This open source learning project is being locally adapted and evaluated with three global partners: at the School of Design, Politecnico di Milano, Italy; Tsinghua University in Beijing, China, and Georgia Tech University in Atlanta, Georgia, USA. In this paper, we describe the general project Dexign Futures and, specifically, the case study workshop conducted at the School of Design, Politecnico di Milano. We briefly describe the general Dexign Futures project and focus on the seminar conducted at the School of Design of the Polytechnic of Milan to show the possible variations to adapt the global model to specific and local contexts.

Keywords: esign-thinking; futures-thinking; open-source-learning; scenarios; time-based-design.

Introduction

Dexign Futures runs in the tradition of global initiatives, such as CUMULUS, DESIS Network, the INDEX Project already engaged in challenges, such as Climate Change, Sustainable Development Goals, Social Innovation, and so forth.

In this paper, we focus on the challenges introduced when design educators are concerned with teaching students to align short-term design action on a temporal dimension to accomplish long-term vision goals. Global problems, such as sustainable development (United Nations, 2015), climate change, climate mitigation and climate adaptation (United Nations, IPCC, 2018), and now the coronavirus pandemic, are among the possible areas of experimentation.

Shifts in design pedagogy

The new issues and transformations that emerged on a global scale entail radical rethinking of the issues on which design teaching has always questioned itself: what (content design); why (Ethical Design on values), when (Time-based design) and how (e.g. pedagogy).

First, for “design what” we assume that Climate Change, Sustainable Development, and Global Pandemics are the most pressing societal challenges about which designers and consequently design educators need to teach new design methods.

Second, with regard to value issues, we consider that an exclusively human-centred Design Thinking process (Brown, 2009) often leads to focusing the vision on the end users, missing broader values like design in the present for collective futures (Fry, 2009); therefore on the short-term needs of an individual, and cannot frame the challenges on a planetary scale, such as the environmental and health ones we want to deal with.

The third point is temporal. Increasingly there is a shortening of time horizons in the present through rapid prototyping techniques

(Chuaet *et al.*, 2010), lean (Ries, 2011), agile (Beck *et al.*, 2001) and so forth at the expense of broader time horizon approaches (e.g., Baghai *et al.*, 2000) or time-based design approach (Barbara, 2018) careful to consider time as an energy, economic and social resources of design.

Fourth, post-human-centred design methods inspired by Futures Studies are urgently needed to augment design thinking methods to overcome limiting human-centred worldviews, epistemologies, and ontologies (Inayatullah, 1998). Design students can learn greater agency within time-based design from Futures Studies pedagogy (Slaughter, 2008). Blended-learning pedagogies involve both online and classroom learning activities (Graham, 2006).

Through the project we explore four research questions:

1. How might a time-based design pedagogy that aligns short-term design action with long-term future vision goals be distributed globally?
2. How might open-source teaching materials developed for one university be adapted by professors and students in a different university, country, language, and local culture?
3. What kind of support do university professors and students need to take on such challenges?
4. How might new local solutions become global open-source learning resources?

Design Pedagogies

Until a few years ago, much of the teaching of design was based on four pedagogical methods: study/laboratory, lecture, and seminar (Lawson and Dorst, 2009; Lyon, 2012; Tovey, 2015; Boling *et al.*, 2015; Fariás and Wilkie, 2016; Davis, 2017).

The digital age has introduced new providers of courses and educational formats into the educational landscape, ranging from the traditional classroom to entirely online courses. The scene is extremely varied, ranging from online courses and degree courses (e.g., SCAD, COURSEERA, UCSD); online master class (e.g., masterclass); post-graduate education courses; to new suppliers (eg IDEO U, IDEO.org, Luma Institute, Cooper Interactive University, Acumen.org).

The Dexign Futures course was taught with a novel flipped classroom pedagogy to support design based reflective practice (Schön, 1990). Reflective practice is critical in design education to embed new ideas and methods firmly into practice. Therefore, the flipped-classroom pedagogy we used has three components: online interactive pre-work with immediate correctness feedback, in-class hands-on workshop activities with instructor feedback, and weekly reflective assignments followed by in-class group discussions to encourage reflective practice (Scupelli and Brooks, 2018).

Dexign Futures

“Dexign” is an experimental form combining design thinking with futures thinking. The term “Dexign” was coined by Arnold Was-

serman in 2013 for the title of a course called “Dexign the Future” (Wasserman *et al.*, 2015).

Given the urgency to rapidly decarbonise by year 2030, it was decided to make the Dexign Futures course materials available globally as open source learning materials with a creative commons license on <https://dexignfutures.org> for university professors worldwide to use, modify, and adapt to their own cultural, social, and national contexts.

The Dexign Futures project originated at Carnegie Mellon University involves global collaborations through a series of pilot studies with professors and students from three universities.

The pilot study at Tsinghua University involves translating the Dexign Futures courses into Chinese on the <https://next.xuetangx.com/> online learning platform. The course materials are being piloted in existing taught design courses. Revised versions of the courses are being translated and modified to be culturally appropriate. The video content is being reshot and will be placed on platforms visible in the Chinese Internet (Scupelli *et al.*, 2019).

The pilot study at Georgia Tech involved introducing graduate level students to the futures thinking method called Causal Layered Analysis (CLA)(Inayatullah, 1998). CLA can augment designers’ creative responses to behavior change challenges by thinking through four layers (e.g., litany, systems, worldview, myths/metaphors). Typically, design students are challenged to apply such theory laden approaches to concrete design problems (Scupelli, 2020).

The pilot study we describe in this paper is organized with the School of Design at the Politecnico di Milano. It was focused on exploring Dexign Futures methodology and the case study.

Challenges of adapting course materials

There are tradeoffs to teaching design related subjects as studio type courses and flipped classroom pedagogy (Scupelli, *et al.*, 2019).

Four differences emerged from adapting course materials developed from one university to another: (a) student types and cultural traditions; (b) professor pedagogy and teaching preferences; (c) teaching infrastructure differences and (d) schedule, time, curriculum, and course constraints. In this paper, we compare exercises created for a flipped class and the same materials adapted to a one-day workshop.

Masdar city: a case-study

We used the case study of Masdar City as a forcing function to have

students explore a utopian technology driven sustainable city future. We chose Masdar City as a case study precisely because it was very different from the life experiences of the students. The contrast to their life experience allowed students to critically question the underlying assumptions of Masdar City (Fig.1).

In this paper, we describe the teaching materials from four units of futures studies methods on Masdar City located near Abu Dhabi, in

the United Arab Emirates. Given Masdar’s focus on sustainability, design students are asked to envision new design products, services, spaces, and experiences within Masdar City (Fig.2).

Case 1. Masdar city - flipped pedagogy - Carnegie Mellon University-School of Design

The Masdar assignment was broken up over 4 weeks focused on four key futures studies ideas. The materials available online focus on four futures thinking methods: STEEP forces (Social, Technological, Economic, Ecological, Political) (ARUP, 2018), common errors in futures scenarios (Cascio, 2012), obligations to future generations (Dator, 2007), and alternative futures (Dator, 2009).

Reflections

The purpose of choosing Masdar City was to challenge students

to use the STEEP framework (social, technological, economic, environmental, and political aspects) as lenses to brainstorm new design opportunities. Students were focused on the design outcome and less on learning a new design process.

Most students had never visited the United Arab Emirates, Abu Dhabi or Masdar City. They lacked understanding the UAE society, culture, economy, or climate. The sustainability focus of Masdar City and the innovative technological design choices were unfamiliar to students. They watched documentaries and read online articles.

Binary thinking led students to be perplexed. How could Masdar City, such an amazing example for sustainable living, be created in a country, whose national economy was mostly based on fossil fuel extraction? Some students reasoned that Masdar City must be a sustainability public relations operation; they struggled to navigate apparent contradictions.

Masdar City forced students to notice that no single paradigm, worldview, or ideas can fully explain the present times. Opposing ideas co-exist in the present and futures. William Gibson said «The future is already here, just not evenly distributed» (Spenser, 1994). Students needed to learn to reconcile apparently opposing ideas, worldviews, and paradigms and design for desirable futures.

Case 2. One-day Workshop at Politecnico di Milano - School of Design

The Dexign Futures workshop held at the Politecnico di Milano involved the graduate students of the Ephemeral Design course of

the School of Design. It lasted a day and was divided into several didactic phases, both traditional and frontal, both flipped and digital. The method of interaction between teachers and students was deliberately left free in the ways and means, therefore the workshop took on, from the very beginning, the character of a community workshop, in which groups of students freely aggregated, arranged in the classroom according to new postures and layouts. The form of



01 | View of Masdar City pedestrian spaces

interaction also changed significantly pro-actively up to a lively final debate among all, including in connection with prof. Scupelli video conferencing from Carnegie Mellon (Fig. 3).

Aim of the workshop

The workshop held at the Politecnico di Milano had an investigative character, aimed at this publication, for a better understanding of how to teach:

- to consider the future as a tool and not as a destination;
- to understand at what distance / proximity from the present, the future must be located;
- to design other methodologies to include the climatic emergency in the project horizons at any scale;
- to study all sources of knowledge and information: human, paper, digital;
- to create a choral narrative of the possible scenarios;
- to check what and who to believe;
- to improve relationship, interaction and empathy between the inhabitants.

Teams

The composition of the class is varied in geographical terms, over 20 different nationalities. This adds to the idea of the future, a multi-cultural dimension that makes the comparison, and debate on the meaning and values of the future, more interesting. Different questions emerged about the value of history and memory, which in the projection seem to become the strength of the project's range,



02 | View of Masdar City with a self-driving transport



03 | Dexist Futures: flipped classroom

especially in a newly founded city like Masdar. Instead, a homogeneity of vision and values is achieved where the future is viewed through the lenses of the climate and its transformations, a topic that seems to make any national distinction inappropriate. Therefore, if the theme of futures is placed in a climatic framework, the concept of country of origin fades before a unitary environmental framework.

Ephemeral and future design

The theme of futures, within the Ephemeral Design course, seems an oxymoron, because it needs to force the temporal projection beyond the temporary deadline of the project. For the purpose of the teaching methodology, the time-based dimension becomes a fundamental axis on which to slide the projection of the visions.



It becomes essential to understand: how far to go, to ask them: how far is their future? What are their concerns and expectations? What future to include in the vision of their projects? What perspective besides the anthropocentric one remains possible? How many futures are possible?

The relationship with futures that students try to establish becomes more strategic than the future itself. It is no longer intended as a forecast, but as a construction and tool for the project.

Masdar city

The choice of Masdar City, in the UAE, as the case study, becomes extremely interesting because through the 5 STEEP forces (social, technological, economic, environmental, political) emerged proposals and critical issues, very coherent between the different groups.

- Social: homogeneity and elitist community. Lack of history. Instant culture. Absence of cars but alienation from new media.
- Technological: overvaluation of technologies. Lack of relationships. Technological pollution
- Economic: not completely independent. Dependence on external supplies.
- Environmental: positive but insufficient for the number of inhabitants expected in the future.
- Political: gated community risk. City branding. Who is the owner of the city?

Discussion

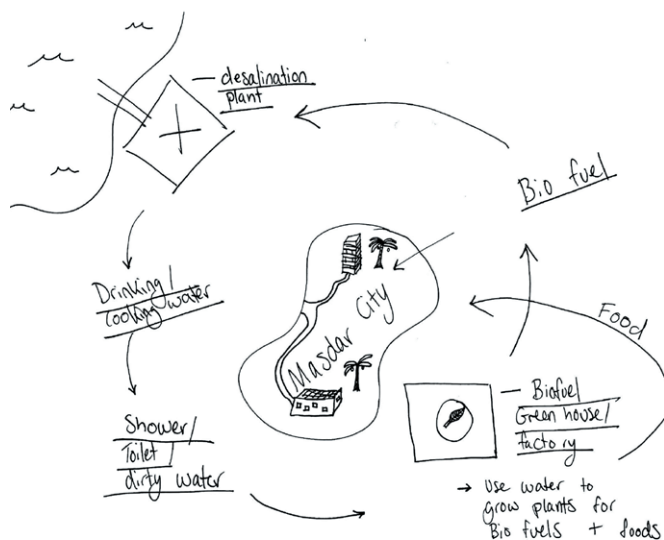
The study of the Masdar, as case study, presents critical issues related to a limited history of the place, since it is a newly founded city. In this sense, students from countries with thousands of years of urban histories (e.g., Europe, China, Middle East) were far more critical than students from countries with more recent urban histories (e.g., America, Australia, New Zealand).

Another interesting factor is linked to the social composition of the inhabitants who are considered too elitist and homogeneous, making the social structure very similar to that of a “gated city” and not to a realistic and complex city. The everyday lives of workers that make Masdar services run were invisible in the online videos.

An evaluation also emerges from the role of the technologies used both in the construction and management of the city, both in the interaction between the inhabitants, and in the control of behaviour and safety. The technological pervasiveness was considered to be extremely invasive in the quality of living and too essential as a medium of relationships. The absence of cars, located on the ground floor of the city, which would allow greater pedestrian interaction between the inhabitants, is likely affected by an excessive presence of digital connection (Fig. 4).

The people themselves are perceived as subsequent “additions” to the project.

1. Natural environment. 2. The city is designed all at once. 3. People as additive elements, not like users.



Masdar’s environmental plan was considered the absolute positive value, as an extraordinary response to the design of energy-efficient environments.

The identified critical issues then became concept, proposals in which, spaces of relationship and greater social and generational diversity, are strengthened (Fig. 5).

Conclusions

We wrote this article before the COVID-19 pandemic gripped the world. We were focused on earth-centred sustainability by aligning short-term design action with long-term sustainability vision goals. We described our challenges translating and adapting design methods and pedagogies from one university reality with the flipped classroom pedagogy to another university focusing with a workshop pedagogy. The realities of social distancing imposed by COVID-19 now force us to think about transitioning to an all-online design pedagogy to teach time-based design. The world has become united by the environmental challenges and new roles to reinvent. Due to the COVID-19 pandemic, the Design Futures Open Source Learning project is shifting to an all online offering that may facilitate global learning. Futures are tricky to predict with much accuracy.

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