

ANNOTATED FAILURE AS A DESIGN COURSE DELIVERABLE

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ABSTRACT

In a course on sustainable design strategies, students explore different notions of what it means to be sustainable and what that, in turn, implies for how one should design products. Many of the philosophical notions that have been proposed (such as Circular Economy, Cradle 2 Cradle, and Biomimicry), and the tools and methods that accompany them, still have substantial shortcomings. As a teacher, I could lecture about those shortcomings and talk about many cases, each with their own particular hurdles, but I deem it more educational for students to bump into, or trip over such hurdles themselves. Enter the notion of Annotated Failure. I ask students to try a sustainable design method until they get stuck, and to submit an annotated version of their design process as a course deliverable. If they reflect deeply on why they got stuck, they will see that often the design method failed them. Still, students often feel *they* failed themselves, even after finishing the course. In a certain sense, this may mean I have failed to adequately implement Annotated Failure as a teaching strategy. This paper serves therefore as an annotated reflection.

Keywords: Failure, tools and methods, sustainable design, annotation, reflection

1 INTRODUCTION

I, myself, was educated at Delft University of Technology in the Applied EcoDesign school of thought, which strongly dominated in the 1990s. It mainly focussed on the technical side of product design, aiming to select better materials, reduce energy consumption, improve durability [1]. The aim often was to find true win-win situations for industry, where environmental improvements also made economic sense. Streamlined LCAs would inform our design process and help validate our designs. We also worked on developing environmental benchmarking processes for companies, in order to anchor EcoDesign into business processes [2]. A lot of progress was made, yet all these tools and methods also had their clear limitations. They for instance have a tendency to favour incremental improvements only. Hence, globally, alternative views and ideas started to emerge, such as Cradle-to-Cradle, biomimicry, design for sustainable behavior, and Circular Economy, to name a few.

Years later, about a decade ago, I attended a presentation on Cradle-to-Cradle at the Dutch Design Week in Eindhoven. The speaker, an architect, talked at length about material flows in buildings. At a certain point, he pulled out his cell phone and asked why we did not design such objects based on the same Cradle-to-Cradle principles. Anyone with an inkling about the design of cell phones would be able to point quite some reasons why not. Instead, the audience enthusiastically nodded their heads in agreement.

This anecdote illustrates a tendency that is rather common in design for sustainability. The philosophical perspective about how the world ought to be organized sounds beautiful and convincing. A few examples where it seems to have worked strengthen the sales pitch. That those examples are precisely the ones where a philosophy makes most sense is lost on the novice design reader. Hence, when teaching on the full range of sustainable design approaches, one needs to go beyond the basic texts, such as [3] for Cradle-to-Cradle, or [4] for biomimicry.

The thinking behind the course described in this paper was further developed by supervising an early MSc thesis on Circular Economy by Florian Mesch [5]). He worked on public lighting products that would have a 15-year lifespan. He found numerous challenges with this, such as available bank loans not extending beyond 8 years, not knowing future recycling infrastructure that far ahead, let alone not even knowing whether the company, at which he did his thesis work, would even still exist at the end of the initial lifespan of his design light fixture. All three questions aren't obviously clear when you start to explore a sustainable design strategy by reading a book or watching a TED talk. And many such books and TED talks have appeared, articulating beautiful notions of how the world should be organised and how design and innovation might help bring such a preferred future about. But there is a clear educational need to move beyond them.

2 A SIDE NOTE: FAILURE IN DESIGN EDUCATION

A second observation on design education on which this paper is based, is that the way design education is set up does not always mimic reality so well. The success rate of design projects in practice is rather low. Yet in an educational setting with design projects, we let all student teams continue to the final presentation (for obvious reasons), even if a stage-gate model is followed. As if no innovation projects are ever terminated for lack of results. Also, to keep things interesting for both students and coaches, we often deliberately choose to take project into novel and therefore high-risk directions. Even if several teams are working from the same brief (not realistic in practice, but common in design education), all teams end up presenting their final result as if it was a good result that should go into production. It would perhaps be better if during final feedback a more realistic reflection would be given as to which projects would have been terminated at which stage gates. As long as the students themselves correctly assess that a design is a (partial) failure there need not be a correlation with their grade. Exploring a design direction that seems promising to arrive at 'no' as an answer can both be an excellent result (with a high grade) and an excellent learning experience.

3 COURSE SET-UP

The course on Sustainable Strategies described here, is a first semester course in our international master's programme in Design. This two-year MSc programme takes in a wide range of students who either have an undergraduate degree in some field of design (e.g., product design, graphics, cabinetmaking, interaction design), or another undergraduate degree with a separate track record in design (we have for instance had students from psychology and electrical engineering). Within the master's programme, students can select a track focused on sustainability, in which case the Sustainability Strategies course is their first track course. Hence, the aim is both to familiarize the students with existing philosophies, methods and tools for sustainable design, but also to let them experience the limitations and shortcomings of these approaches. The learning objectives in the syllabus are therefore as follows: "The main objective is for students to develop knowledge about, and skills for different perspectives on sustainability and associated design strategies. After the completed course the student shall be able to:

- Articulate the differences between visions on sustainability and their associated design strategies,
- Argue for the selection of a specific strategy in light of a given challenge, while articulating its limitations,
- Independently apply one of the strategies to a design challenge.

Over the course of 10 weeks, we start with jointly reading some basic texts in the first few weeks, to align the knowledge level of the varied group of students. We start with two papers that present an overview of different perspectives on sustainable design [6-7], followed by De Pauw's empirical comparison based on student teamwork [8], part of a basic text on Circular Economy [9] and finally, because the ones above are mostly on environmental sustainability, a text on design justice as part of the social side of sustainability [the introduction of 10]. In two sessions we discuss the reading material seminar style, after which students select their own focus. After several years, I see Biomimicry and Design Justice as two very popular focal points in our programme. Students continue reading individually for a couple of weeks, to familiarise themselves with the philosophical notion of their chosen strategy, and the methods and tools that have been developed for them. If they choose biomimicry, they might read more of De Pauw's work [e.g., 11-12] and if they choose design justice, they might read Perez book on invisible women [13] or Kristof Vaes' work on stigmas surrounding

prosthetics [14]. This focussed reading material is selected with the help of the instructor. We continue to have joint seminar-style sessions in which we discuss the reading, so that all students hear about each other's chosen focus strategies.

Subsequently, they try out their focal sustainable strategy on a very small design project (on which they spent roughly 8 working days). But here is the thing: they are not asked to deliver a finished design. Instead, they are required to submit an annotated design process up to the point where they got stuck. So, the deliverable is not the usual finished design, but rather an Annotated Failure. Students find this very challenging ("*You know I'm gonna ask you five more times, right?*"), because they feel it means that they themselves have failed, instead of the sustainable strategy, method or tool they employed, which is actually coming up short.

The notion of Annotated Failure as the course deliverable was to some extent a consequence of allotting sufficient time for reading in the beginning of the course, and the limitation of having only 6 ECTS credit points. Reading previous research consists of about a 100 pages per week for the first weeks. This reading yields much deeper insight than if I were to select a single design for sustainability manual as course literature. However, in hindsight, I feel the notion of annotated failure turned out as a valuable educational model. There are of course links to the notion of productive failure [15], but it is different in the sense that it is the final deliverable and not a step towards finding a final design.

4 STUDENT EXPERIENCES

By trying to execute a cradle-to-cradle project, or a biomimicry project, or a design justice project, and getting stuck because of information that is unobtainable for a student, undoable within a timespan of the course, or because decisions need to be based on the unknown availability of recycling technology in 2035, they gain much deeper insights into what such strategies both can and cannot do. Of course, many of the projects bump into limitations related to the limited time and the limitations of the pre-existing skills of students either regarding sustainability skills or regarding the primary functionality of their product. For instance, regarding acoustic modelling for a sound booth made of renewable materials. The skills of the students are a limitation, but *also* the available data for such relatively new materials compared to more traditional engineering materials.

Another student, working on material wear and aging as a topic, wrote "*The explanations are easy to understand and it is possible to visualize what the authors mean by them. However, it was difficult to actually implement these in my own design proposal. There are certainly materials that can fit the project better, or that age in a more graceful way, but the difficulty lay in implementing more than just one of the proposed strategies in the same project. Another difficulty is knowing whether your proposal actually meets these criteria. What is really unique and how do you celebrate imperfections?*"

Examples of limitations of the tools and methods students uncover, are for instance the data needed about materials in Cradle to Cradle, especially regarding potentially present trace molecules. (This of course combined with having some base chemical knowledge and skills which students might not have). Many companies will be reluctant to release their proprietary production info. For large, and rich, companies there are ways to deal with this, but for students or independent designers it may present insurmountable hurdles.

In Biomimicry, we search for inspiration in nature. There is debate about terminology, but here we take biomimicry as generating solutions that are sustainable on a system level, not just technical inspiration which might be captured by the term biomimetics. In the seminal book by Janine Benyus [2] there are many examples, but they all originate with biologists realising that nature has a wonderful solution, that might solve problems in real life. Starting with a given problem is a whole different game. "Ask a biologist" is the advice, yes, but which one? Is nature's solution to your problem located in an insect from the amazon, or a plant in the alps? or both? The work done in Delft in the Nature Inspired Design project[12] helps, but problem-driven biomimicry projects remain challenging.

Due to time limitations within the course, actually demonstrating through some proper validation, that your idea works is often also beyond the scope of the course. An example here is the work by a student, Petter Alsén, working on the aerodynamics of a hydrodynamic power generator by applying irregular shapes inspired by a Humpback whale's tubercles (the irregular bumps on their flippers) [16-17], see Figure 1. Even though a computer simulation or prototype test is beyond the scope of the course (and in this case also beyond the skill set of the student), it is possible to clarify how such a validation could be done. Hence, by asking for an annotated design process up to the point they get stuck, students (hopefully) feel more empowered to actually say that beyond the point where they ended up, they simply

do not know. Instead of the usual claim of self-confidence in their unvalidated design.



Figure 1. Models of the hydrodynamic power generator with tubercles. (credit Petter Alsén)

5 CONTRASTING ANNOTATED FAILURE AND PRODUCTIVE FAILURE

As said, there are some similarities between Annotated Failure and Productive Failure [15,18]. They are however distinctly different:

Productive Failure lets students explore a problem in an *unguided* way first, relying on their pre-existing knowledge and skills. By analysing the resulting sub-optimal and incorrect solutions found, a deeper understanding of the current limitations of the *students'* abilities are made explicit, creating a need-to-know for tools and methods that can help them find the optimal solutions.

In Annotated Failure, students familiarize themselves with a sustainable design philosophy with its associated methods and tools, and then try to apply those in a *guided* way, until they get stuck. The reason they get stuck may partially rest upon limitations in their skills and knowledge but is predominantly a limitation of the *tool or method* used.

6 FEEDBACKS TO STUDENTS

The cohorts taking this course have been very small, with the largest groups being 8 and 9 students respectively. This allows for more direct contact between teacher and students, and a form of continuous formative feedback. (Which includes repeatedly articulating that getting stuck means the method or tool is failing them in the contexts of their project; they are not failing themselves). In the more summative feedback at the end, I re-iterate the learning objectives of the course, and reflect how the student developed themselves in light of those. This is done in an individual message, which should look like this, slightly edited, actual example:

“By choosing what, in essence, is a very simple product, you were able to dive into three sustainable strategies instead of just one. Reading through your reflections of the different philosophies and as well as tools, I see a repetitive theme: The theory is beautiful, but practice is unruly. How does a strategy deal with making compromises in practice?

I feel you really experiences (and can now articulate) the strengths and weaknesses of C2C and biomimicry. On the EcoDesign side you took one specific version of EcoDesign (not the most common definition) but that is fine.

Based on your documentation, I'm entirely confident that, given a specific product design challenge,

- *You could now select which sustainable design strategy to apply (and explain why),*
- *You would know to some extent how to execute it and would know for which aspects you would need to dig deeper.*

As a close of the course, it may be nice to look at the graph of Ceschin and Gaziulusoy, to reflect on which part of the field you now explored. (and whether you agree with where they placed your strategies)”

Formal grading happens on a fail/3/4/5 scale, with 3 being sufficient, 4 being good and 5 being excellent. Because this is a scale with rather wide steps, there is usually limited focus on reaching a higher grade. (The feedback example above represented a solid 4).

7 REFLECTIONS FROM STUDENTS

At the end of the course, in informal feedback, students express an ongoing unease with the unfinished nature of their projects. It is so different from what they are used to in the course deliverables during their undergraduate programmes, that they struggle to distinguish between the tools and methods failing them, or they themselves falling short.

It is obvious though, that students do honestly discuss the limitations of their project. It seems the course does provide the context in which they are confident enough to do so.

Several students have returned to the topic and/or method of this initial course when it became time to select their thesis project a year later, in some cases truly picking up where they were forced to leave it at the end of the course. As one student wrote: “Unfortunately, I did not get as far in my design process as I had hoped. Time was short and I got stuck a few times on the way. I would therefore like to take inspiration from this project and further develop it in another course.”

8 FINAL REFLECTIONS

Many of the methods and tools available for the different approaches to design and sustainability have serious limitations. The same would apply to other relatively new design fields. When teaching those approaches, it is important to make students aware of those limitations and have them realize that they may cause failure in a design project. Such failure is not necessarily their fault, or a limitation of their skills and knowledge.

Asking students to submit an Annotated Failure as their final deliverable of a design course helps them to develop a more mature stance in relation to failure, detaching the quality of the process (and the quality of the learning) from the quality of the result. It also helps them develop a more realistic picture of what a particular sustainable design strategy can and cannot do.

The course has run for 6 years now, with a total of 27 students. Which means there is quite some experience, but numbers are too low for now to attempt any kind of quantitative analysis. Also, the small badge size allows for personal coaching and feedback which may make this educational set-up hard to scale to larger cohorts. The students have explored a wide range of directions from stigma-free wheelchairs and gender-neutral toilet signage on the social side of sustainability, to behavior change projects around thermal comfort in households of migrant families, to biomimicry in hydropower generation. Some students came closer to a finished design than others. All still found the notion of handing in an Annotated Failure challenging. Nevertheless, several students have come back to their attempt in this first semester course once it was time to articulate their thesis project. So, it does seem to have made an impression on them.

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