Net-Zero Design Education. Transition to “Better States” in Understanding Carbon and the Design Process

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Net-Zero Design Education. Transition to “Better States” in Understanding Carbon and the Design Process

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Abstract
Design education must adapt to the changing attitudes of student designers, and industry immediately. The consequence of how we design shapes the attitudes, values, and decisions student designers make across a professional career. Design education must be responsible for how they facilitate a course and the projects they deploy. Decision-making in the process of designing subsequently develops values and impacts that transcend beyond a design course. The research adopted a mixed-methods approach comprising of semi-structured interviews, questionnaires, and data tracking of an undergraduate visual communication cohort. Activity data enabled understanding of the cultural, leadership and transitioning challenges associated with the design process. The project surfaced gaps in the organisation, knowledge, process, skills, tools and technologies embedded into the design process. This research situates a critical pivot in design education demanding a cultural shift for a Net-Zero world.

Keywords
Design education
Net-Zero
Pedagogy
Anthropocene
Design for planet

Whenever humanity seems condemned to heaviness, I think I should fly like Perseus into a different space. I don't mean escape into dreams or into the irrational. I mean that I have to change my approach, look at the world from a different perspective, with a different logic and with fresh methods of cognition and verification. (Calvino, 1988, p.7)

This research intends to understand the behaviours and actions of design students and quantify the collective weight of practice in university design education settings. The lack of empirical data related to the carbon intensity of the design process demands a better awareness and understanding of carbon activity conducted in design education situated within higher education settings.

"Most of the environmental impacts of a product are determined by the product designer" - "Decisions made during that stage profoundly influence the entire life cycle of the product and determine 80 to 90 percent of its total life-cycle costs" (Graedel, Comrie & Sekutowski, 1995, pp.17-25).

The research surfaces important factors in relation to carbon and design education by means of qualitative and quantitative research methods to understand students' perspectives, insights and behaviour tracking of activity data regarding carbon intensity and the critical impacts that take place when engaging in a design process.

The highlights of the research outcomes fall into two main categories. Key factors regarding personal perspectives from a visual communication student cohort and quantitative data analysis conducted by the researcher in which activity tracking was implemented on a design and make project. The data collection gathered from student design activity had a focus on understanding what had taken place and how this related to the carbon intensity of the actions or tools implemented as part of the design process.

Students Personal Perspectives

In the research, students share attitudes to carbon and the climate crisis. Perceptions of knowledge regarding design capability and the ability to adopt sustainable ways to practice. Identification of issues and challenges with complicit personal behaviours that suggest key consequences and actions. The frustration of the scale and pace of change alongside generational attitudes is evident in their beliefs, understanding and values as developing designers.

Design Process: Analysis of a Student Project

The researcher interrogated and surfaced the student's modes of practice when designing outcomes through data collection. Identifying key activities and essential tools. The researcher asked the students to map activity to a foundational framework used in the UK and globally for the design process, the Design Council's Double Diamond framework (Design Council, 2004). This helped support and quantify the findings by providing an established approach to structure student design activity. Tools and different types of activity are identified and quantified regards carbon intensity with scaled

modelling used by the researcher to suggest potential impacts of the approach beyond this pilot cohort. General matters of working with a cohort are considered, such as travel to reflect on the impact of choices regards timetabling, commute locations and working on or off campus, which help clarify and situate the general issues in higher education settings, alongside the specific impacts of facilitating design education.

The need to understand the immediate and long-term consequences of carbon as a designer is essential. Over a life cycle, designers must consider how they potentially develop and evaluate the associated impacts of a product, service or system. Importantly the need for foresight and scope to understand consequences before you embark on designing becomes paramount to an individual, team or organisation.

The need to revisit design education has been accelerated by publications such as *Changing Design Education for the 21st Century* (Meyer & Norman, 2020) and the recent United Nations (UN) paper *Making Peace with Nature* (2021), suggesting a need to "Develop environmental education programs for all age groups" (UN, 2021). It is also pertinent to highlight that the World Design Organisation and 600 volunteers worldwide are reconsidering the *Future of Design Education* (Norman & Vrendenburg, 2019).

Bremner & Rodgers (2019) suggest that for the future design school, we need to learn from the world and devise new models for living and making with a damaged Planet. Design innovation, ecology and the economy are now inseparable components of the UK's post-COVID economic recovery plan, it is suggested (HM Government, 2019). Friedman (2019) suggests, "The top problem is the kind of preparation designers need to address today's broad problems".

Boehnert, Sinclair & Dewberry (2022) underline the potential gap by suggesting that "Designers need more than good intentions and basic design skills when approaching complex eco-social problems". Several authors have outlined "why" we must shift to a life-centred approach in the age of the Anthropocene (Meek Lange, 2012; Zylinska, 2014; Anderson, 2015; Jagodzinski, 2019). The creative industry's voice for systemic change also suggests an ambition to change with many climate change manifestos developed over a large time period (*First Things First*, 1964, 2014; IAM, 2019; *Do the Green Thing*, 2019; *Music Declare Emergency*, 2019). However, foreground research has found few examples that interrogate the design process and its collective weight and the impacting consequential follow-on behaviours regarding design. Interestingly Noel (2022) indicates "The futures of design education will be pluriversal as we will learn to co-exist with many ways of doing design that draw on personal histories, a range of identities, localities, and a diversity of motives".

This inquiry is urgent and of strategic importance to the UK design education sector. Adaption to curricula, methods, processes and delivery to support and develop future-facing graduates as advocates for contemporary social and environmental practice is essential to continue to enhance the world-leading design education provision situated in the United Kingdom.

Methodology

The Double Diamond framework was used as an analysis tool and structural foundation for the process of how students conducted design on the project. The framework helped the researcher understand and identify challenges and opportunities in the process of facilitating design for students. The intention was to use research methods to identify and scope the range of behaviours in design education settings and also quantify the subsequent impacts by means of surfacing the cohort's embodied carbon emissions.

This project is situated in the discipline of Graphic Design, based in an Art & Design school in the North of England in the United Kingdom. The cohort was made up of final-year undergraduate students. The project was implemented to enable students to "think through making" in an approach to help them engage the broader design community of peers, industry and policymakers with the climate crisis in the context of design. The researcher also wanted to focus on collecting activity data from the cohort to provide a useful and foundational data set to underpin and complement the student perspectives he had gathered to understand design activity and the potential impacts of the design process.

A key focus was to understand the potential for carbon emissions within the process of activities undertaken. The researcher wanted to triangulate the findings with the British Design Council's Double-Diamond methodology (Discover, Define, Develop and Deliver) to help substantiate the findings and be able to correlate the activity in the different stages of the Double Diamond for review and reflection.

In the delivery of the project, students had been asked to consider how they might transition to a "better state" in the context of their own practice situated within the growing need for adaption to a Net-Zero/Real Zero approach as a professional designer. The outcomes from the project had been specified to engage the students to think about how they could develop the projects to inform or endeavour to mobilise a pre-defined audience of peers, industry or policymakers using visual communication as a vehicle for change. The students recorded and shared their quantitative activity with the researcher by employing the use of an activity Pro-forma. The Pro-forma was a simple A4 analogue document they could use daily, allowing the students to record activity at the point of need. The Pro-forma considered factors they had been undertaking, such as the process (analogue or digital), tool (analogue or digital), material and duration of activity, etc. Importantly the Pro-forma asked them to identify at what stage of the Double Diamond (Discover, Define, Develop and Deliver) they perceived this activity to be taking place in order to help triangulate this to the framework. Students submitted a proforma sheet every week for four weeks to collect key data relating to the design activity they had conducted on the project. The pilot had ten participants, and seven participants successfully returned viable data. Qualitative research methods from focus groups and questionnaires helped the researcher understand further the broader student perspectives, values and beliefs regarding design, carbon and the increasing prospect of a Net/Real Zero transition.

The mixed methodological approach enabled the students to start intervening even after a few days on a personal level without any tutor direction. The request for the data through the Pro-forma became a transparency tool for practice. This approach triggered an autonomous response in which students started to develop a "quantified self" position that surfaced design practice, repeat behaviours, tools and durations. The methodology presented a live picture of how students had been designing and indicated the consequential impacts of decisions made in the process. The approach provided a simple system to record and identify the different activities, tool selection and durations to interrogate a designer's carbon emissions. The data capture recorded and presented in this way initiated a change in the designer when they could quickly see how much or little they had been doing within the framework and the impacts of the decisions made. Subsequently, the methodology and its data visualisation began to influence the student's project direction and by reflecting on personal actions started to surface challenges or complicit behaviours with others such as peers or other professionals. The methodology was conducted in a way that provided valuable data, alongside encouraging agency in the students to think about how they could understand current practice and make positive decisions in how they might adapt behaviours in the future as designers. The proforma touched on areas that considered the duration of time in different phases of the Double Diamond, what tools they might use, material selection and the relationship of input versus outcome in the design process. The researcher also provided simple calculations for the designers so they could start to quantify the carbon cost of using technology, materials and the scaling factors of duration and frequency in how this impacts carbon emissions.

Findings

The research surfaced qualitative and quantitative data that suggested commonality in personal beliefs about how they wanted to operate and develop as designers. Students highlighted gaps in personal knowledge and suggested limitations in the appropriateness of curriculums and the lack of potential leadership in the space of design and education. Students acknowledge fear and anxiety around the future and the potential lack of urgency at a planetary level. Interestingly, the data tracking conducted by the researcher also provided insights into common behaviours of students when designing and, more generally, being a student in a higher education setting, the tools and systems they interface with and the duration of usage, suggested critical contact points for how we shape, consider and approach the design process moving forward.

Design Process

In considering the phases of the Double Diamond model (Design Council, 2004) and how this related to student design activity, the data collection asked students to indicate what phase of the Double Diamond they felt the activity fitted into when developing that specific aspect of the project. In looking at the holistic view of the data

set collected and considering time and activity, the cohort spent a large proportion of time in the early stages of the Double Diamond in the development stage and earlier on in the framework. Tab. I

	Double Diamond Phase			
Activity in hrs	DISCOVER	DEFINE	DEVELOP	DELIVER
	94	143	133	63

Tab. I
Student activity in relation to the Double Diamond.

The data suggests a larger proportion of the activity took place in the first 3 stages [Discover, Define, Deliver] that related to project development, around 370 hrs and only 63 hrs collectively being used to actually deliver the project. This data suggests different intensities and ultimately, different amounts of resource usage, be it energy, time or materials in the process of designing. This data set also demonstrates the potential for significant amounts of impact (carbon emissions) in the early stages of the design process. This asks the question of what is appropriate in terms of time, resources and activity in relation to the operational or functional requirements needed by any designed outcome. In reality, "how much is enough" or "appropriate".

Attitudes

When questioned about how they felt about the climate crisis? Students understood and "continue to be troubled by the crisis" and "wanted to help" but didn't precisely know how, it seems. A "sense of duty" became evident from the cohort when they started to voice and consider the crisis as developing designers, and suggested an important focus on "what they designed and how they output". Students also suggested frustration with the "lack of change in the sector". Time and speed of response felt to be a real concern to the cohort regarding progression against scientific climate targets.

Knowledge

Students demonstrated engagement and awareness of the issues but lacked confidence, it seemed. Interestingly the students suggested "a lot has to change in our daily lives", the speed of change again seemed to continually frustrate them in conversations. The action seemed imperative for them, which they wanted to address personally and seemed to demand further engagement from society as a whole. As designers, they wanted to design in sustainable ways but suggested gaps in the knowledge base and not being entirely sure of their ability to really "design sustainably".

Behaviour

Students suggested thinking bigger and broader regarding the scope of possibilities and potential actions as designers. They are uncomfortable, it seems, with the past and a wastage model approach to design and the potential to output often “useless things”. Students seemed shocked by the amount of waste and energy consumption when they started to quantify themselves when undertaking the data-tracking activity. They commented on the close circle of organisations and peer networks they connected with and stated “they hate being the problem” and suggested real ambitions to stop or reduce in areas of personal and professional life as designers. In interviews or when completing questionnaires, the cohort projected elements of guilt or shame in some of their micro-actions and that of their peers or broader network.

Technology

The most common tool adopted by the cohort was a laptop. Students were actively conducting a range of activities for a total of 292hrs over the 4-week period. This amount is significant when you consider the data set as being only one element of a very small cohort’s working week on a year-long level 6 120-credit undergraduate graphic design module.

This suggests Tab. II that even a small cohort can generate a significant impact if we model this across a standard 38-week academic year, regards energy usage as only one potential factor of the design process. This one tool, when taken in isolation, when we start to consider the potential of all the students in a typical design school, the duration of activity and all the infrastructure and systems each device can be potentially connected or interfaced with, again scales in complexity and significance regarding carbon.

	Technology		
No of hrs used	Laptop	Desktop	Tablet
	292	36	13

	No hrs day	No hrs week	No hrs month	No hrs aca year
	10	73	292	2774
Co2e kg	0.16	1.19	4.76	45

Tab. II
Co2e data projection of a small cohort of designers in a standard 38-week academic year. (*Calculation based on an average laptop 70 watts and energy supply factor .233kgCo2e).

Commute

The students’ travel was analysed and the modes of transportation were separated into distribution across cars, trams, trains and walking, with the cohort’s shortest round trip being just 1.8 miles and the longest being 75.4 miles from campus. If every student in this cohort attended a single workshop once a week, they would collectively travel a staggering 181 miles collectively, with an average of 22 miles per student, per day. Tab. III

Pilot cohorts commute [modeller]	Per day	Per month	Per year
Collective distance in miles for project	181	724	6878
Typical face to face contact would be 2 days a week at this level	181	1448	13,756
CO2 by transport CAR [50% of travel is by car]		724 miles = 144t CO2	6878 miles = 1376t CO2

Tab. III
Scaled travel data over a 38-week academic year.

Conclusions

This research is an initial pilot, and the researcher understands the limitation of the intervention and data collection in terms of scale. The limited geography in terms of discipline was also a factor the researcher must acknowledge in terms of substantive findings. The pilot, however, is intended to foreground a larger, more detailed and rigorous study for which funding is currently being sought. These outcomes and the projected scenarios by the researcher provide initial student insight, analysis and large-scale considerations for the design education community and the need to develop this research project at a national level across the United Kingdom. The behaviours identified in this project and the ones currently perpetuated across design schools generally support the creative industries' future prosperity. The 2022 Design Economy report stated "In 2019, the design economy contributed £97.4bn in GVA to the UK economy, 4.9% of total UK GVA." And "In 2020, there were 1.97 million people working in the design economy – or one in twenty workers in the UK. Of these, 1.62 million were designers" (Design Council, 2022).

Design Education

The research situates a compelling need for change in design education in adapting to changing attitudes, the wants and needs of new student designers and how they conduct practice inside and outside of higher education in a planetary-facing context. The design sector must consider what the implications of this research suggest and how this can be translated to facilitate and develop an optimised approach to design education. The mitigation of impacts and justification of high-value relevant experiences for students using appropriate curriculum, tools, theory and carbon-efficient processes and methods becomes a fundamental starting point and should not be left as a happy accident or small pockets of innovation in some design education or professional practice settings. Collectively design education must transition to better states in terms of the activity, tools and techniques employed to facilitate design education. As suggested in this pilot study, design education needs to disseminate further opportunities to develop a robust and practical sustainable knowledge base for young designers at every level of education. The expansion of the pedagogic approach to help support the development of sustainable methodologies and literacies for staff and students in design schools is a priority to help them understand how design can develop and revisit the process of designing to

positively impact the planet. The endeavour to help positively shape designers, their practice and society are ongoing. However, the need for this transition is immediate.

The link between the divergent and convergent phases of the Double Diamond and the relationship to activity alongside the vast range of tools and technologies implemented by the designer warrants further investigation. Students need additional ways to make sustainably and become increasingly knowledgeable in new or existing practice as Net/Real Zero designers. Design education has to be responsible for how they facilitate a course and really consider the projects and briefs they facilitate in the context of a Net-Zero world. Importantly higher education must enable education to be delivered and facilitated in a positive and transparent way, considering not just curriculum and content but also infrastructure, estates, travel and deployment of the workforce, as they all factor in and contribute to success in a Net/Real Zero higher education transition.

Carbon Intensity of the Design Process

The relevance of the Double Diamond as a framework still holds currency in the process of designing. However, this research suggests the process can be problematic regarding carbon intensity and the need for critical decision-making before, during and after the design process. The research suggests the need for a pre-project phase of the Double Diamond to fully consider the process and life cycle analysis of all potential impacts for the project or outcome when undertaking the design and development of any product, service or system, so designers can make and validate positive decisions that consider the potential endpoint or regenerative aspects of any solution or developments.

Findings from the research become apparent when we consider the data and subsequent carbon emissions that are suggested when we start to interrogate the day-to-day behaviours of design students and their collective actions in higher education settings. The consequence of how we approach design education as an institution and the mechanics of education and the design process will inevitably shape the attitudes, values, and decisions student designers make on the course and as they move forward from graduation into professional practice. Alongside the associated carbon impacts of facilitating design education on design courses, we must also step back and consider the broader impacts and potentially complicit behaviours at scale across the UK higher education sector and its contribution to a Net/Real Zero transition from this research.

Framing a design brief, module or course as having a carbon envelope suggests useful guidelines to provide some immediate mitigation against the potential impact of excessive emissions and control activity that can have profound long-term effects on the planet. The development of essential parameters for good practice and national standards across the design sector will be essential to provide guidance, develop standards and promote ethical practice. This simple yet critical approach in which an individual or collective team has to consider and surface potential impacts through analysis and scoping of potential impacts whilst considering optimization at the pre-phase of a design process suggests a need to increase the positive decision-making a designer must make in the pre-phase of

designing any product, system or service. Subsequently, the development of these values and methodological approaches can then become normalised as a baseline and will eventually, over a course, transcend far beyond the project and filter into practice beyond the institution. The need for further research and a larger scale enquiry built on the initial data capture has surfaced gaps in the organisation, knowledge, process, skills, tools and technologies associated with the design process and how we conduct, develop and facilitate design education. Carbon is an essential yet hidden metric that must be transparent in its systemic reach across the sector and carefully managed by design schools in how they frame, shape and execute world-leading design education.

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