

Design and ecoliteracy. Developing a Design and Sustainability Course with 21st-century Relevance

Diseño y ecoalfabetización. Desarrollo de un curso de diseño y sostenibilidad con relevancia para el siglo XXI

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ABSTRACT

In the current social, political, and environmental scenario, this paper is based on qualitative research and looks to recover experiences and highlight empirical findings from the process of building the Design and Sustainability course for the Industrial Design Department at Rafael Landívar University, acknowledging the role of ecoliteracy as a critical ability for 21st-century designers. Additionally, this paper briefly discusses the present flaws of the current design and ecological literature and how this affects the ecological literacy process, particularly when considering experiences in the context of the case study. Finally, the discussion centers on the Design and sustainability course. The course has successfully run for two years and has become a tool to enrich the environmental perspective of future industrial designers.

Keywords: design education, sustainability, ecological literacy, environment, contextualized design.

RESUMEN

Considerando el contexto social, político y ambiental actual, este artículo busca recuperar experiencias y resaltar hallazgos empíricos del proceso de construcción del curso de Diseño y Sustentabilidad para el Departamento de Diseño Industrial de la Universidad Rafael Landívar, reconociendo el rol de la ecoalfabetización como un elemento crítico dentro de la oferta pedagógica, una habilidad necesaria para los diseñadores del siglo XXI. Este documento busca compartir los puntos clave del proceso de diseño metodológico necesarios para conceptualizar este curso de pregrado. Además, presenta una breve discusión de las fallas y faltas actuales de la literatura sobre diseño y ecológica y cómo esto afecta el proceso de alfabetización ecológica, en particular cuando se consideran las experiencias en el contexto del estudio de caso. Finalmente, la discusión se centra en el curso Diseño y sostenibilidad, el cual ha sido implementado con éxito por los últimos dos años y se ha convertido en una herramienta que enriquece la perspectiva ambiental de los futuros diseñadores industriales.

Palabras clave: educación en diseño, sustentabilidad, ecoalfabetización, medio ambiente, diseño contextualizado

INTRODUCTION

Welcome to the Anthropocene! An era dominated by human agency and its impact on the geological composition of The Earth (Crutzen, 2002). A period of generalized Earth degradation, major collapses in biodiversity, and where the oceans, forests, and species are at risk like never before (Bonneuil & Fressoz, 2017).

One of the most prevalent narratives about nature in the Anthropocene, is the unintended consequences leading to environmental decline (Fallan & Jørgensen, 2017, p.117). As stated by the IPCC (2021), ecological breakdown occurs due to societal disruption in the natural environment, highlighting how human development has become a threat to the natural systems, but emphasizing how solutions should also be human based. The world faces climate change, ocean acidification, biodiversity loss, forced migration, ecosystem collapse, and many other systemic problems which require immediate action. Therefore, it is crucial for everyone to actively contribute to developing multidisciplinary solutions (United Nations, 2020) that respond to these *wicked problems* (Rittle & Webber, 1969).

In this context, there is a clear need to develop a proper understanding of the world's problems within the academic setting to foster ideas of change by delivering knowledge that can be integrated into actionable routes. Building these knowledge capabilities in students can help them develop a long-term awareness of the role of design and nurture their critical and systemic perspective of the world.

Focus has been placed on understanding environmental problems, and the capacity to move from theory to action is known as ecological literacy (Orr, 1992). Today this literacy is critical as Ecological knowledge will become the foundation for the development of informed decision-making (Boehnert, 2015) that will help individuals to develop consistent and systemic solutions for the world while considering trade-offs, benefits and alternatives. Humanity is living in the space race of contemporary times (Mazzucatto, 2022), and conscious action is needed to overcome what is yet to come. In this era of change, the world is living in the last decade for action; hence mobilization is urgently needed to embrace the ambition to

supercharge ideas into solutions and use the spirit of human endeavor to deliver extraordinary change (United Nations, 2020). Design and design practitioners need to play an active role in this challenge.

This paper aims to share the non-linear process of structuring a design educational framework for the Design and Sustainability course, sharing experiences of curating relevant information and how comprehensive sourcing was integrated to enrich the course content under a logical structure. However, the essential point is to highlight how the educational experience influences and will influence the design practice of the future generation graduating from Industrial Design at Rafael Landívar University now that there is a course aiming to develop their ecological literacy. Moreover, after acknowledging some critical gaps in literature from the global south perspective, the discussion looks to analyze and present ideas of how this course can become a stepping stone for developing consciousness and strategies for long-term care of our Common Home.

METHODOLOGY

This paper provides a literature review which contextualizes ecological literacy, its relevance to design practice and education and the localized history of industrial design at Rafael Landívar University in Guatemala. The analysis is based on two areas: the process necessary to conceptualize the course and the experiential student-based feedback.

Methodological design

The focus is to collect previous experiences of the processes of upskilling others through ecoliteracy, mainly based on qualitative examples of what is Ecoliteracy and how it can be delivered in the academic environment.

In the case of the previous experiences of ecoliteracy, there is a need to do a literature review which can provide a general approach to the concept. This information was complemented with a benchmark of case studies of similar examples of design and ecoliteracy in action. The information was organized to report the main find-

ings, presenting how those feed into the process of developing the course in the context aided by the lecturer's own experience and expertise. Additionally, the students' experiences are relevant from a qualitative approach to identify how those receiving the content experience the knowledge-transfer process. Most of these experiences are documented as course evaluation and coursework development. However, it has also been complemented with a small selection of semi-structured interviews from students who have been part of the Design and Sustainability course and some personal notes that helped structure the academic experience.

LITERATURE REVIEW

In the context of design and sustainability, some of the best well-known literature dates to the 20th Century with Victor Papanek (1971) and Bauhaus (Gropius, 1965). Particularly, Papanek's (1971, p. IX) words became considerably relevant and well known: "There are professions more harmful than industrial design but only a few of them". Papanek's critique to design considered how products were being designed even when people did not need them, bought when people could not afford them, and used for unimportant purposes. He considered the dangerous bread of industrial designers vandalized the world and that morals, ethics, and responsibility were needed to revindicate designers' names.

Eco literacy

Concept and relevance for design

Ecological literacy is a term that became relevant in 1992, coined by David Orr (1992) to highlight the role that ecological understanding had at a pedagogical level across all disciplinary traditions (Harkness, 2019). Since then, many sustainability educators from all disciplines have used it to describe engagement with creating new ways of living and acting through introducing innovation, creativity, and technology. But what is ecoliteracy or ecological literacy?

Ecological literacy is the capacity to understand the implication and systemic nature of the world regarding the environment (Orr, 1992). Ecological literacy aims to create a frame of mind that recognizes relations and interdependency with the natural world and supports the development of new capacities to create sustainable ways of living (Boehner, 2015, p. 1). This pedagogical approach explores the “roots of our problems, not just the symptoms“ (Orr, 1992, p. 88), allowing comprehensive responses to emerge from this knowledge. Moreover, Ecological literacy demands a type of education that nurtures the capacity to think broadly: a skill that has been “lost in an era of specialization” (Orr, 1992, p. 87). This broadness is needed to help practitioners gain perspective on the real-world repercussion of decision-making. However, ecological empowerment and literacy are still a significant challenge, mainly in design and design schools. Certain practices like the creative one has disconnected from the capacity of scoping and digging to develop a deeper understanding of its role, ethics, and impact (Boehnert, 2015).

Nevertheless, there have been many changes in the last decades where design has recognized its role and contribution to environmental problems (Harkness, 2019). Defining sustainability in design has become particularly relevant as an opportunity to expand the role of design interaction with the real world. In formal education, particularly in higher education, there has been an acknowledgement of the synergic nature between design and sustainability (Boehnert, 2018). Most of the recognitional movement can be dated back to Victor Papanek in 1971 when he referred to industrial design. He stated: “There are not many professions more dangerous than design. Designers are a dangerous breed.” That 1971 statement is a big inning of a long journey where the interactions between the sign and sustainability become more significant on where the possibility is expanded, notably by introducing multidisciplinary approaches to design.

Ecological literacy is relevant across all disciplines but is especially important in design. The design practice engages with creating new ways of living on the objects and platforms presented by the creative design process. Design should be held accountable regard-

ing the systemic effects they can harm people in nature (Boehnert, 2015). Designers are mainly responsible for designing future sustainable ways of living, so perhaps also be very much implicated in the current crisis and detrimental effects of the Anthropocene (Harkness, 2019). Therefore, in Boehnert's (2015, pp. 2) words,

it is no exaggeration to say that the future of humanity rests on our capacity to become ecologically literate and to design sustainable ways of living. There will be no long-term future unless this goal becomes possible. For this reason, ecological literacy is a comprehensive learning program requiring a curriculum and research culture in design education.

Benchmarking educational initiatives targeting a ecoliteracy in the Design context

The contemporary design practice is shifting from the traditional areas –like graphic, fashion, interior, and product design to more systemic approaches– (Norman, 2010; Sercombe, 2019) and pushing the understanding of what design can do concerning the world's most wicked problems. Design complexity is the reality that is faced across the globe, and experiences in higher education are developing day by day. One of the main methods used to develop the Design and Sustainability course was to benchmark and understand other educational initiatives' scope and framing. As environmentalism has grown exceptionally in structure and higher education environments, diverse cases were selected to exemplify the baseline for developing ecoliteracy experiences.

Environmental Design: Materials, ecologies, Futures
by Dr. Rachel Harkness at the University of Edinburgh

This example is included because it was directly experienced by the appointed lecturer as part of her formal education during the Design for Change master's degree. Therefore, it was chosen because it constitutes the more critical and real-life experience that enriched the process of developing D&S. Harkness's course started in 2018 (The University of Edinburgh, 2021) and was designed for under-

graduate and postgraduate students. In this course, students will be accompanied by a variety of thinkers and doers, writers, and designer-makers, as they consider the question of how people's relationship with and understanding of the environment, in turn, fashions and impacts upon environments, peoples, and organisms. It is a course that will invite students to consider the fact that the benefits and effects of environmental change are unequally distributed in the world, and it will provide them with a sense of how global processes connect social actors at all scales (from the very local – even molecular– through regional, national, international to global) (The University of Edinburgh, 2021). The four themes explored by the course are 1) Experience and the Environment: Design and the Senses, Making, and Consumption; 2) Stories of Stuff: Labor, Social Justice, and Design; 3) Materials and (New) Materialism: Bodies, Resources, and Pollution; and 4) Environmental Futures: Time, Hope, and Possibilities in Design.

*Environment-led Design programs
at the University of the Arts London*

University of the Arts London has a unique approach to introducing open environmental-led design programs into their educational offer. Primarily, UAL master's degree courses focus on different aspects of sustainability, such as materials, fashion and sustainability, and bio design, and it recently introduced the regenerative design program, which started in the fall of 2022 (University of the Arts London, 2022). This example was selected because of its progressive and rapid adaptation to world trends. These courses are master's level specializations, but they are still relevant to illustrate the interlink between design and ecological literacy in different scenarios in a leading academic institution.

**Eco literacy in Rafael Landívar University
industrial design program**

The long process of adaptation of educational curricula required recognizing the complexity that ecoliteracy represents in the design context. In the context of the industrial-defined bachelor's degree

at Rafael Landívar University (2022), late institutionalization (Morales, 2019, p. 164) could have played a role in waiting until 2021 to start delivering a sustainability-specific course into the curricula.

Design, particularly industrial design, is a widely unknown discipline in the Guatemalan context. Industrial design as an undergraduate degree was formally institutionalized in 1980 (Morales, 2019), allowing for a higher educational degree recognition to its students and for the curricula to be reinforced. However, considering the limited professional pathways and applications of design (Guatemala being a non-industrialized country mainly with artisanal and traditional productions), after more than 30 years the degree reach 400 graduates just in 2014 (Morales, 2019). This environment, however, has changed as the understanding from employers has evolved around product (industrial) design, considering the capacity the discipline has shown all over the world. Today industrial (product) design plays a vital role in tangible and intangible products and services. Nowadays, three universities in Guatemala (including Rafael Landívar) are delivering similar programs at the undergraduate level.

Therefore, it was only in 2018 that the last update of the curriculum for the Industrial design degree at Rafael Landívar University was introduced with some significant changes in the context of ecological literacy. Previously, sustainability started with the gentle approach, a product focus approach within the scope of eco-design. With a soft perspective, the theory was only introduced as complementary to design-practice studios without deepening the main theories fundamental to the practice. However, with the new curricula, a specific and theoretical course was introduced, which looked to develop a deeper understanding of the wide variety of topics that connect design –particularly product design– with the world of sustainability. In this context, the connectedness between environment and design is recognized in the late stages of the program, delivering the course to third-year students because it is considered that at this point of the degree the critical aspect of design has been developed and is easier to just “add” an extra layer to the processes and methods of design.

RESULTS: THE CASE OF THE NEW *DESIGN AND SUSTAINABILITY* COURSE

As the appointed lecturer of Design and Sustainability, the main objective was to translate as much environmental knowledge to students at a level that allows maximizing concept exploration while exploring details and applications. The course offered a vision of the sustainability principles concerning design. It highlighted how sustainability is a transversal axis in design, approaching the discipline from a holistic and systematic perspective.

It addresses the responsible role of designers in the social, economic, and environmental spheres, allowing the proposal of comprehensive solutions and alternatives conceptualized using a creative design process. The aim is to allow future design practitioners to be a catalyst for positive changes and consider the repercussions of the design world from a critical decision-making approach, or as Boehnert (2015) would say, to have critical ecoliteracy applied to the practice of design.

This course considers people's relationship with the environment and the economy and the tensions between these three pillars (Cato, 2011). It exposes relevant perspectives in the process of building a sustainable future. It seeks that students understand that sustainability and environmental conservation are as crucial to design as innovation, aesthetics, and strategy.

The aim for students is to understand the social, environmental, and economic impact of design on products, services, and processes, accompanied by knowledge and awareness of tools that allow designers to create conscious and sustainable designs. Additionally, they intend to help them integrate sustainability in their design processes as a fundamental principle and not just as a value proposition. Overall, the experience allows students to become ecologically literate at a level that allows them to apply sustainability concepts to their design practice (Valenzuela, 2020a).

During the course, sustainability concepts were explored to highlight the importance of its principles as a transversal axis in design and offer tools that allow the student to observe the scope of design, its products, and its executors from a critical perspective.

Teaching ecoliteracy in design: curating relevant design and sustainability principles

The current Design territory of action has pushed designers out of their comfort zone and into the comprehensive reality of the world where problem framing for design is looking to go beyond Papanek's approach to designers' share in actual problem resolution (image 1). There is a push to make visible the responsibility and interconnections of what happens when designers intervene in building new solutions for the world (Harkness, 2019; Thackara, 2015). However, this design-practice expansion to the extensive territory has not been smooth. Boehnert (2018, p. 3) states that ecoliteracy has primarily failed to spread across disciplinary boundaries over two decades since the concept was first conceived. It remains marginal in education, policy, and practice. In this context, the curation process of the Design and Sustainability course required an open mind to select the leading sustainability problems concerning design. However, the course needed to be complemented with action approaches to identify how students experienced their ecoliteracy process.

■ Image 1. Course original briefing

- Sustentabilidad: ¿Qué es y por que es importante?
 - Sustainable Development Goals
 - IPPC Report
 - The planetary Boundaries
 - Paris Agreement

- Fundamentos del Diseño Sustentable
 - Victor Papanek
- Modelos de diseño sustentable
- Análisis del Ciclo de Vida
- Estrategias del Eco diseño
- Producción y consumo Sostenible
- Economía Circular –

- Socio-Eco-Literacy – Alfabetización en medio ambiente
- Pesamiento sistémico y diseño
- Recursos y Materiales
- Doughnut Economics (Diseño regenerativo y distribución por medio del diseño)
- Contexto social
 - The Antropocene
 - Innovación social
 - El Pluriverso (Arturo Escobar)
 - Historia
 - Labour (mano de obra)
- Moral y diseño

Source: prepared by the author.

As a result, the program of a consistent yet dense and diverse course emerged, which is considered the latest development in design academia. Additionally, the greater sense of the course was complemented by self-directed research, which helped visualize different matters which will become relevant to the role of teaching design in the Guatemalan context. As a result, the original Design and Sustainability course covered ten main areas considered relevant to the practice of design (image 2).

■ Image 2. Original design and sustainability structure

#	Tema	Descip	Actividad actual
1	¿Dónde estamos hoy?		En trio, realizar un esquema que explicando los puntos principales de las lecturas, como se interconectan los tres temas y que creen que falta o no se considerado por el autor
2	¿Cómo se relacionan?	Los tres pilares de la sostenibilidad - Relación con diseño	Agregar 6 definiciones que consideres importantes -Leer el documento del ISM tool y hacer una reflexión de cómo esta los puede ayudar en un proceso de diseño
3	Definiendo un Diseño (producto y/o sistema) sostenible	Las estrategias de sostenibilidad - Ejemplos de sostenibilidad	Ensayo - Identificar un material innovador y las posibles aplicaciones del mismo
4	Materiales en un mundo sostenible	El hacer énfasis en los materiales nos da la oportunidad de considerar los "bloques" con que construimos el proceso de diseño desde la raíz	Ingresar a https://ecoberry.org.uk/ y medir su huella de carbono personal, tomar un screenshot de su resultado y escribir una reflexión (signa: 500 palabras) sobre acciones que podrían tomar para disminuir dicha huella.
5	Impacto ambiental del diseño	Neces del desarrollo sostenible Huella hídrica Huella de carbono Utilización de tierra	
6*	Impacto social del diseño	El diseño puede ser un cómplice o una herramienta de combate de los problemas complejos del mundo (Justicia Social)	
7	Diseño social	Diseño responsable - Innovación social y diseño - Diseño activista - Diseños para el pluriverso- Diseño Responsable	Escribir su propia definición de diseño social, aproximadamente entre 450 y 650 palabras
8	Biomimética - Biomimesis	Recursos para practicar: incluir: experimentar, conceptualizar con Biomimética	Una fotografía o scan de la documentación de su observación, una fotografía del lugar donde observaron y la respuesta a esta pregunta: ¿Cuál de estos aspectos podría aplicar en mi próximo diseño?
9	Ciclo de vida del producto	Tipos de ciclo de vida Lineal - Reciclaje - Circular	Debate sobre ciclos de vida del productoeconomía circular
10			
11	Economía en un mundo sostenible	Valor vs precio, Modelos económicos alternativos: Economía circular Economía de las donas, Economía azul - Economía sostenible aplicada - Empresas sociales, ¿Certificaciones? Buenas y malas prácticas, El diseño en las nuevas economías	Ver documental <i>Steamparty</i>

Source: prepared by the author.

However, during and after the implementation of the first pilot course in 2021, the context needed further expansion as it was identified that, even if the course could become a bit denser (being this an undergraduate fundamental course), it was important to allow students to approach as many facets of sustainability as possible. This will encourage them to go further on their explorations and discover all the possibilities interlinked between the practice of design, the concept of ecoliteracy, and the implementation of sustainability and its principles. Therefore, in the seven months between both cohorts, there were some critical analyses and reflections undertaken to expand the theory presented in class. Three structures were developed (images 3, 4, and 5) to try to align the content under major umbrella topics that could help students approach this process of learning from a structure that was relevant in the defined context.

Image 3. Alternative course structure 1 for design and sustainability

Tema principal	#	Tema	Descripción original	Propuesta de descripción	Material de lectura	Posible / actividad
Fundamentos del diseño sostenible	1	(¿Dónde estamos hoy?)	¿Qué pasa en nuestro mundo no concierne a la sostenibilidad?	¿Qué pasa en nuestro mundo no concierne a la sostenibilidad? Como un emprendedor mundial para ser a la cabeza por agotar la producción - Diseño de agotar Cero a la tierra	There is No Planet B, Verónica 2021 (Esta edición cuenta la perspectiva de haber creado una pandemia mundial). Earth is finite, David Orr - Sustainable Development Goals	
	2	Impacto del diseñador en la sostenibilidad	Los tres pilares de la sostenibilidad - Relación con el diseño - Descripción de pasado/diseño de diseñador - Descripción de futuro/diseño	Los tres pilares de la sostenibilidad - Relación con el diseño - Descripción de pasado/diseño de diseñador - Descripción de futuro/diseño	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Leer el documento del DSM tool y hacer una reflexión de cómo está hoy el mundo y cómo se debe abordar el diseño.
	3	Impacto ambiental del diseño	Hechos del desarrollo sostenible: Huella hídrica y huella de carbono. Utilización de la tierra	Hechos del desarrollo sostenible: Huella hídrica y huella de carbono. Utilización de la tierra	Green Design and Materials for Sustainability	Clase de Huella de Carbono
	4	Impacto social del diseñador	El diseño puede ser un catalizador o una herramienta de control de las problemáticas emergentes del mundo (Justicia Social)	El diseño puede ser un catalizador o una herramienta de control de las problemáticas emergentes del mundo (Justicia Social)	The Green City and Social Justice - The Green City and Social Justice	
Avances en programas sostenibles de diseño	5	Definiendo un Diseño (producto y/o sistema) sostenible	Las estrategias de sostenibilidad - Ejemplos de sostenibilidad	Las estrategias de sostenibilidad - Ejemplos de sostenibilidad	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Investigar la carta de la tierra. Escribir una propuesta para la tierra y para el diseñador.
	6	First dimension of power: Computation - Ciclo de vida del producto - Systemic Design	¿Diseñar sistemas productivos de base local en los que se respaldan de un proceso productivo sostenible en el mundo por el primer productor? - Ciclo de vida del producto - Reciclar - Circular - Reciclar y re-diseñar	¿Diseñar sistemas productivos de base local en los que se respaldan de un proceso productivo sostenible en el mundo por el primer productor? - Ciclo de vida del producto - Reciclar - Circular - Reciclar y re-diseñar	Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	
	7	First dimension of power: Computation - Materiales en un mundo sostenible	El hacer diseño en las materias más allá de la disponibilidad de recursos de la tierra, con qué materiales se procesa el diseño desde el día 1	El hacer diseño en las materias más allá de la disponibilidad de recursos de la tierra, con qué materiales se procesa el diseño desde el día 1	Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar - Identificar un material no utilizado puede ser un desafío. ¿Cómo se puede utilizar mejor? ¿Cómo se puede re-diseñar?
	8	Second dimension of power: Exclusion - Diseño social	Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor - Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor	Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor - Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor	Social Innovation, Materials & New Approaches to Social Design - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Escribir un pequeño artículo de diseño social, aproximadamente entre 400 y 600 palabras.
Materias de la sostenibilidad	9	Segunda dimensión de poder: Exclusion - Diseño social	El diseño basado en la ecología responde a las necesidades de la cultura y el progreso de un material. En cultura y el progreso de un material. En cultura y el progreso de un material.	El diseño basado en la ecología responde a las necesidades de la cultura y el progreso de un material. En cultura y el progreso de un material. En cultura y el progreso de un material.	Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Hacer una investigación de la materialidad nativa de la región. ¿Puede ser un buen material? ¿Qué materiales se pueden utilizar? ¿Cómo se puede utilizar? ¿Cómo se puede utilizar?
	10	Third dimension of power: Influence - Biomimética - Biomimética	Recursos para practicar: incluir, separar, reciclar, reutilizar con Biomimética	Recursos para practicar: incluir, separar, reciclar, reutilizar con Biomimética	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar un concepto de biomimética que puede ser aplicado en el mundo.
	11	Third dimension of power: Influence - Emotionally Durable design(EDD) / Design for sustainable behaviour(DSB)	Fomentar y entender el el tiempo y el producto - crear que las personas estén en un comportamiento sostenible y responsable.	Fomentar y entender el el tiempo y el producto - crear que las personas estén en un comportamiento sostenible y responsable.	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar un concepto de EDD que puede ser aplicado en el mundo.
	12	Acciones actuales y Compromiso de Cambio	Ejemplos de acciones actuales en la actualidad (Sostenibilidad - Acuerdo de París, Objetivos de Desarrollo Sostenible)	Ejemplos de acciones actuales en la actualidad (Sostenibilidad - Acuerdo de París, Objetivos de Desarrollo Sostenible)	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Analizar la acción de la tierra que involucra a los diseñadores y a los usuarios. ¿Cómo se puede utilizar? ¿Cómo se puede utilizar?
	13	Economía en un mundo sostenible	¿Vale la pena? Modelos económicos alternativos. Economía circular. Economía de la tierra. Economía social. Economía colaborativa. Economía de la tierra. Economía social. Economía colaborativa.	¿Vale la pena? Modelos económicos alternativos. Economía circular. Economía de la tierra. Economía social. Economía colaborativa. Economía de la tierra. Economía social. Economía colaborativa.	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Analizar la acción de la tierra que involucra a los diseñadores y a los usuarios. ¿Cómo se puede utilizar? ¿Cómo se puede utilizar?

Source: prepared by the author.

Image 4. Alternative course structure 2 for design and sustainability

Tema principal	#	Tema	Descripción original	Propuesta de descripción	Material de lectura	Posible / actividad
Fundamentos del diseño sostenible	1	(¿Dónde estamos hoy?)	¿Qué pasa en nuestro mundo no concierne a la sostenibilidad?	¿Qué pasa en nuestro mundo no concierne a la sostenibilidad? Como un emprendedor mundial para ser a la cabeza por agotar la producción - Diseño de agotar Cero a la tierra	There is No Planet B, Verónica 2021 (Esta edición cuenta la perspectiva de haber creado una pandemia mundial). Earth is finite, David Orr - Sustainable Development Goals	
	2	Impacto del diseñador en la sostenibilidad	Los tres pilares de la sostenibilidad - Relación con el diseño - Descripción de pasado/diseño de diseñador - Descripción de futuro/diseño	Los tres pilares de la sostenibilidad - Relación con el diseño - Descripción de pasado/diseño de diseñador - Descripción de futuro/diseño	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Leer el documento del DSM tool y hacer una reflexión de cómo está hoy el mundo y cómo se debe abordar el diseño.
	3	Impacto ambiental del diseño	Hechos del desarrollo sostenible: Huella hídrica y huella de carbono. Utilización de la tierra	Hechos del desarrollo sostenible: Huella hídrica y huella de carbono. Utilización de la tierra	Green Design and Materials for Sustainability	Clase de Huella de Carbono
	4	Impacto social del diseñador	El diseño puede ser un catalizador o una herramienta de control de las problemáticas emergentes del mundo (Justicia Social)	El diseño puede ser un catalizador o una herramienta de control de las problemáticas emergentes del mundo (Justicia Social)	The Green City and Social Justice - The Green City and Social Justice	
Avances en programas sostenibles de diseño	5	Definiendo un Diseño (producto y/o sistema) sostenible	Las estrategias de sostenibilidad - Ejemplos de sostenibilidad	Las estrategias de sostenibilidad - Ejemplos de sostenibilidad	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Investigar la carta de la tierra. Escribir su propia carta a la tierra y para el diseñador.
	6	Acciones actuales y Compromiso de Cambio	Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor - Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor	Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor - Diseño responsable - Innovación social y Diseño activo - Desafíos para el primer productor	Social Innovation, Materials & New Approaches to Social Design - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Escribir un pequeño artículo de diseño social, aproximadamente entre 400 y 600 palabras.
	7	Ciclo de vida del producto - Systemic Design	¿Diseñar sistemas productivos de base local en los que se respaldan de un proceso productivo sostenible en el mundo por el primer productor? - Ciclo de vida del producto - Reciclar - Circular - Reciclar y re-diseñar	¿Diseñar sistemas productivos de base local en los que se respaldan de un proceso productivo sostenible en el mundo por el primer productor? - Ciclo de vida del producto - Reciclar - Circular - Reciclar y re-diseñar	Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	
	8	Economía en un mundo sostenible	¿Vale la pena? Modelos económicos alternativos. Economía circular. Economía de la tierra. Economía social. Economía colaborativa. Economía de la tierra. Economía social. Economía colaborativa.	¿Vale la pena? Modelos económicos alternativos. Economía circular. Economía de la tierra. Economía social. Economía colaborativa. Economía de la tierra. Economía social. Economía colaborativa.	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar un concepto de biomimética que puede ser aplicado en el mundo.
Materias de la sostenibilidad	9	Emotionally Durable design(EDD) / Design for sustainable behaviour(DSB)	Fomentar y entender el el tiempo y el producto - crear que las personas estén en un comportamiento sostenible y responsable.	Fomentar y entender el el tiempo y el producto - crear que las personas estén en un comportamiento sostenible y responsable.	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar un concepto de EDD que puede ser aplicado en el mundo.
	10	Diseño basado en la ecología / Materiales en un mundo sostenible	El diseño basado en la ecología responde a las necesidades de la cultura y el progreso de un material. En cultura y el progreso de un material. En cultura y el progreso de un material.	El diseño basado en la ecología responde a las necesidades de la cultura y el progreso de un material. En cultura y el progreso de un material. En cultura y el progreso de un material.	Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Hacer una investigación de la materialidad nativa de la región. ¿Puede ser un buen material? ¿Qué materiales se pueden utilizar? ¿Cómo se puede utilizar? ¿Cómo se puede utilizar?
	11	Biomimética - Biomimética	Recursos para practicar: incluir, separar, reciclar, reutilizar con Biomimética	Recursos para practicar: incluir, separar, reciclar, reutilizar con Biomimética	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	Enseñar un concepto de biomimética que puede ser aplicado en el mundo.
	12	Diseño en tiempos de crisis - Design resilience	Una forma que el diseño industrial puede crear sostenibilidad en el mundo y crear resiliencia, proveer la capacidad de recuperación de crisis de sostenibilidad. - The Resilient Design Principles	Una forma que el diseño industrial puede crear sostenibilidad en el mundo y crear resiliencia, proveer la capacidad de recuperación de crisis de sostenibilidad. - The Resilient Design Principles	Sustainable Design - Sustainability - Design for Sustainability - Design for Sustainability - Design for Sustainability	

Source: prepared by the author.

■ Image 5. Alternative course structure 3 for design and sustainability

Tema principal	#	Tema	Descripción original	Propuesta de descripción	Materiales de lectura	Posible / actividad
Fundamentos del diseño sostenible	1	¿Qué es sostenibilidad hoy?	¿Qué es la sostenibilidad? ¿Cómo se relaciona con la sostenibilidad? Como una estrategia mundial para el desarrollo sostenible. (Carter & Burgess-Limerick, 2003)	¿Qué es la sostenibilidad? ¿Cómo se relaciona con la sostenibilidad? Como una estrategia mundial para el desarrollo sostenible. (Carter & Burgess-Limerick, 2003)	Therrell & Patten. A world 21st (en español) con la perspectiva de haber pasado una generación mundial. (Carter & Burgess-Limerick, 2003)	
	2	Impacto del diseñador en la sostenibilidad	Los tres pilares de la sostenibilidad. Relación con el diseño. Metodología de diseño de sostenibilidad. Diseño con diseño.	Los tres pilares de la sostenibilidad. Relación con el diseño. Metodología de diseño de sostenibilidad. Diseño con diseño.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	Leer el documento del IMU y hacer una reflexión de cómo está el país según un proceso de diseño
	3	Método para explorar los aspectos ambientales, sociales y económicos de la sostenibilidad.	Impacto ambiental del diseño. Herramienta de diagnóstico de sostenibilidad. Herramienta de diagnóstico de sostenibilidad. Herramienta de diagnóstico de sostenibilidad.	Herramienta de diagnóstico de sostenibilidad. Herramienta de diagnóstico de sostenibilidad. Herramienta de diagnóstico de sostenibilidad.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	Calcular de Huella de Carbono
	4	Impacto social del diseño	El diseño social. El diseño social. El diseño social. El diseño social.	El diseño social. El diseño social. El diseño social. El diseño social.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
	5	Impacto integral del diseño	El diseño integral. El diseño integral. El diseño integral. El diseño integral.	El diseño integral. El diseño integral. El diseño integral. El diseño integral.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
	6	Definiendo un Diseño (producto y/o sistema) sostenible	Los conceptos de sostenibilidad. (Concepto de sostenibilidad)	Los conceptos de sostenibilidad. (Concepto de sostenibilidad)	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
Aplicar el proceso sostenible al diseño	7	Ciclo de vida del producto - Systemic Design	Tipos de ciclo de vida. Linear - Recycle - Cradle. Valor en precio. Modelos económicos alternativos. Economía circular. Economía de la salud. Economía de la salud. Economía de la salud.	Tipos de ciclo de vida. Linear - Recycle - Cradle. Valor en precio. Modelos económicos alternativos. Economía circular. Economía de la salud. Economía de la salud. Economía de la salud.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
	8	Economía en un mundo sostenible	El diseño en un mundo sostenible. El diseño en un mundo sostenible. El diseño en un mundo sostenible. El diseño en un mundo sostenible.	El diseño en un mundo sostenible. El diseño en un mundo sostenible. El diseño en un mundo sostenible. El diseño en un mundo sostenible.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	Ver documental Sustainability
	9	El diseño sostenible (DESIGN) / Design for sustainable behaviour (DSB)	El diseño sostenible. El diseño sostenible. El diseño sostenible. El diseño sostenible.	El diseño sostenible. El diseño sostenible. El diseño sostenible. El diseño sostenible.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
Más allá de la sostenibilidad	10	Diseño basado en la ecología y Materiales en un mundo sostenible	Diseño basado en la ecología. Diseño basado en la ecología. Diseño basado en la ecología. Diseño basado en la ecología.	Diseño basado en la ecología. Diseño basado en la ecología. Diseño basado en la ecología. Diseño basado en la ecología.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	
	11	Diseño social	Diseño social. Diseño social. Diseño social. Diseño social.	Diseño social. Diseño social. Diseño social. Diseño social.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	Escrito en el programa de diseño social, aproximadamente entre 450-600 palabras
	11	Biomimética - Biomimética	Recursos para practicar, incluir, experimentos, conceptualizar con Biomimética.	Recursos para practicar, incluir, experimentos, conceptualizar con Biomimética.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003	Diseñar un producto del puntado 10 puntos. (Ver el programa de diseño social, aproximadamente entre 450-600 palabras)
12	Diseño en tiempos de crisis - Design resilience	Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia.	Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia. Una forma que el diseño industrial puede proporcionar es la resiliencia.	Sostenibilidad: Diseño y Sostenibilidad. Carter & Burgess-Limerick, 2003		

Source: prepared by the author.

Finally, after evaluating each topic's scope, time, and appropriateness, a final structure was defined. The final syllabus of the course was based on five main areas which define the baseline of the Design and Sustainability course: Awareness and contextualization, Waste and materiality, Vibrancy and the social life of objects, Footprints, and Design developments and futures.

Awareness and contextualization

Understanding the systemic nature of the world (Meadows, 2008) at the beginning of an Ecoliteracy process allows for awareness of the role that design has in connection with sustainability. It is essential first to acknowledge that fragmentary thinking is an obstacle to sustainability (Boehnert, 2018) to push for initial approaches to the learning process to move beyond reductive attitudes. Once this first barrier is overcome, learners address complex ecological systems and social, economic, and wicked problems. In response to this dilemma, ecological literacy provides an integrated foundation for understanding environmental problems and potential solutions (Boehnert, 2018).

The introduction starts by understanding the Anthropocene and underpinning the main critical topics on the urgent need to use human power and innovation to develop solutions because there is no planet B (Berners-Lee, 2021). This introduction is used to debunk and untangle the main sustainability issues and acknowledge the active role and level of agency that creative and design practices have in this context.

It established that the introduction must highlight where the world is today and how degradation and conflict are happening worldwide. Images from the Anthropocene exhibition (Burtynsky, 2017) are the first point of contact to establish a visual story of the world today. The lecturer narrates them as a story of change and degradation (image 3). This information is complemented by a set of exponential graphics presented by Steffen et al. (2005, p.132-133) (image 6) known as The Great Acceleration (Steffen et al., 2015), and the introduction of the limits of the planet (Rockström et al., 2009, p. 1). These three concepts help illustrate the environmental impact and establish the importance of slowing the damage rate following the planet's limitations.

■ Image 6. The Great Acceleration



Waste and materiality

Waste has been present in the social realm since the beginning of time, but what do we understand as waste? If we were Mary Douglas (1970), we would say it is a matter out of place. This approach was highly relevant to developing the linear economy waste management perspective. However, under current environmental transitional approaches, materiality, and the ways it is constituted, are shifting. There is a need to introduce the cradle-to-cradle approach (McDonough & Braungart, 2002) and mainly dedicate an in-depth exploration of the circular economy under the circular design toolkit from the Ellen MacArthur Foundation (EMF). EMF widely recognizes the role that designers, mainly product and industrial ones, play in rebuilding the economy (EMF, 2019), which can be expanded and complemented with the regenerative approach explained under the perspective of Doughnut Economics (Raworth, 2017).

However, the material realm goes beyond just re-managing current well-known materials. In the construction of the future world of sustainability, materials themselves need to be redesigned as they are believed to be a way of integrating design with ecology (Franklin & Till, 2019), localization, and innovation (Proctor, 2015). Emphasizing materiality enables the reconsideration of the building blocks of the world and specifically of the design process, allowing changes to happen from the bottom up (Franklin & Till, 2019). There is an opportunity to rethink today's waste and create a framework of alternative extraction, restructure harvesting and production processes to allow natural assets to be maximized and produce minimal waste, reimagine detritus as alternative sources, use traditional environmental knowledge and artisanal techniques to develop unexplored alternatives which mix folklore, ecology, and technology (Watson, 2022, p. 60), to design under the perspective of no trace and appropriate degradability, and to bio-mimic and bio-produce based on nature's genius and 3.8 billion years of research and development (Benyus, 2002).

The vibrancy and social life of objects

Although sustainability is usually understood from the environmental perspective, caring for the world also means caring for its people and its connectedness with the materiality that builds ways of being. This people-centered approach is highly relevant for the design practice as many authors believe that societal interactions with designed objects provide specific ways of living and interacting with the world (Boelen & Kaethler, 2020; Design Studio for Social Intervention, 2020). Additionally, this considers how stuff can be perceived as a vibrant matter (Bennett, 2010) with its own meaning and purpose. Additionally, in its process of interacting with humans is fear. This vibrant matter can carry ontologies of the world, politics, culture, and cycles of social interaction. In other words, the stories of stuff highlight how objects are responsive to manufactured narratives such as those of the economy (Leonard, 2010).

Moreover, the social life of objects is widely interlinked with human behavior allowing for interactions to be shaped by psychology (Steg & De Groot, 2018) and emotion (Chapman, 2015) which help develop contextual valuations of the material world. This cognitive-emotional consideration of the human relationship with the material world highlights how being lateral is the process of making, mainly designing. Therefore, behavior analysis frameworks such as ISM (individual, social, material), when considering defining sustainability intervention concerning human interaction, can provide a more realistic approach to the full power that the environment and its objects have in the process of shaping behavior, including environmentally compatible behaviors (Darnton & Horne, 2013).

Finally, objects by vibrancy and social life are particularly relevant when considering the perspective of the making of worlds in the context of the pluriverse (Escobar, 2018). The connections, reconfigurations, reframing, and reallocation of objects can help form interactions and ideas with a high level of uniqueness, cultural pertinence, and identity (Escobar, 2018, p. 1-9). This last matter is briefly introduced as one of the frontiers where design could develop in decoupling, relearning, and decolonizing designers' practices.

Footprints

Footprints were one of the central areas of interest of the appointed lecturer as widely presented in her master thesis *Facts per Serving: Designing an Information-based strategy to disclose environmental and nutritional facts to challenge food behavior* (Valenzuela, 2020b). Although a variety of footprints exist, and they are deeply connected with the materiality approach of design, the decision to separate footprints into their categories was driven by the acknowledgment of how these methodologies are deeply rooted in environmental studies more than design. In this exploration, the footprint considered on the Nexus of sustainable development (Ritchie, 2020), carbon, water, and land, was used as the introductory and simplified approach to the actual impact that human stuff produces on the environment. Terms such as carbon literacy (The Carbon Literacy Project, 2010) are covered to underpin the embedded impact that products derived from the design process can have. Additionally, real-world examples are presented to compare everyday objects and their carbon footprints (Berners-Lee, 2010). This illustration helps students further understand the concept, its implications, and how vital these technical perspectives are to evaluate material selection and other processes in design critically.

Design developments and futures

Interesting practice acknowledgment of the future has become a well-known strategy to illustrate possibilities of development change and the construction of different realities. Therefore, adding a touch of future studies into the curricula is vital to help students visualize and build their narratives of the world they want to see. There is literature on this topic, but potentially, *The World We Made* by Porritt (2013) was one of the introductions considered relevant to bring context to the course. approaches futurity from a perspective of how the 2050 work would look like by giving examples of human innovation and technology development. This content is highly relevant and designs context as it portrays the role of objects and systems defined to provide the future presented in the book's examples.

Additionally, unwilling to give a light, positive, and approachable context to future-making, Thanckara's (2015) perspective in his book *How to Thrive in The Next Economy* is introduced as a tool that bridges the reality of today with the results of tomorrow. Lastly, and considering a critical review of the role of design, Fry's (2009) perspective in *Design Futuring* helps close the cycle of rethinking the context in which they define practice should happen. It includes an Acknowledgment of what he calls the reorientation and definition based on sustainability ethics, and the future approach to its application (Fry, 2009).

Critical analysis: ecoliteracy Global South challenges

The stability of the Earth's systems is compromised. Therefore, sustainability must be considered in all professional practices. Industrial designers recognize their role in developing the material world and the social interactions derived from it, and the role of ecological literacy in nurturing this practice becomes crystallized. Understanding the design is just a tiny part of the tapestry, and a meshwork of the interconnected world helps push individuals into building a more conscious and informed practice (Ingold, 2011).

There is an active recognition of how the evidence presented about critical ecological literacy developed during this course is limited. However, analyzing the experience and gathering the current qualitative and available quantitative backing information has been a process to understand at a deeper level what should be included in developing ecoliteracy in undergraduate design students in the Guatemalan context.

By embracing systemic thinking in the design context, one of the main areas identified as literature-poor was the approach of decolonization studies. As is believed and expressed by the lecturer and the students themselves, many of the experiences presented in the literature can be seen as alien or potentially widely displaced when considered for their application to rural, indigenous, and local scenarios. Similarly, just a quick scan of the literature available to develop the current paper can help illustrate the lack of diversity in sustainability studies. Most of the design literature (if not all)

today is widely presented from a westernized/northern approach, making it difficult to relate directly to the ongoing reality of the Global South.

In that context, if design education concerning ecoliteracy does not acknowledge this contextual conflict, with a risk of turning designers into the hidden villain. Therefore, this paper opens to discussion on how we should question the teaching and unlearning of design and ecoliteracy with the capacity to acknowledge 21st-century problems, particularly those of localization, Global South storytelling development aggression, and power struggles.

For Design and Sustainability to embark on this questioning, an open exploration of this struggle is needed even beyond the context of the course and to investigate ongoing discussions to undercover decolonial perspectives for sustainability application. Here it is an open invitation to everyone to nurture Ecoliteracy-related education and develop more appropriate and localized frameworks to care for our Common Home.

DISCUSSION: THE EFFECTS OF ECOLITERACY ON THE NEW GENERATION OF DESIGNERS

Now, after two years of running the course, over 80 students have experienced the academic enrichment of this subject. One of the main concerns about the course results was creating an evaluation technique to oversee critical perspectives on design-led intervention. It will challenge students to develop solutions based on their visions of the world and their critical judgment. A project-based approach was considered an appropriate coursework technique to present own worldviews and perspectives. In that context, Wicked Problems Design Studio was conceived as a fictional consultancy in which groups of four students will need to develop sustainability interventions for an identity problem of their choice.

Applying ecological literacy, Wicked Problems Design Studio is a knowledge expansion exercise that aims to encourage industrial design students to think beyond the niche and specialization environment in which they have been trained. The process starts by pushing students to identify, map and present detailed research

highlighting the pressure on contemporary issues that they can observe in the real world, which be linked to social and environmental problems. Once this stage is set, students must work under our defined base methodology of their choice to begin the process of exploration and acknowledging what design can do in their problem space. After the framing is developed on the critical exploration finishes, students must present an alternative scenario to help mitigate controversies under the selected problem space. However, the exercise is not about solutions but critically exploring the problem by applying ecological literacy to develop design-led proposals. They need to present and interlink all relevant tools, contents, and theories learned during the Design and Sustainability course to provide an appropriate background justified by theory on the application to practice.

Although this is the expectation of results after being part of this design course, there is some qualitative and quantitative evidence to back this statement. On one side, the final project developed by the students and the overall marks achieved on the course can be used as a proxy for how the content was uncritically utilized in another project. Additionally, the consideration of a passing rate of over 90% (Universidad Rafael Landívar, 2022) could also be introduced as a guideline to identify the process of ecoliteracy in the making, as well as some final valuation comments explaining their central learning in the course (images 7 and 8).

However, possibly one of the most enriching experiences in this process of criticality analyzing the content of the Design and Sustainability course is the actual experiences from previous students that were collected through the process. Short semi-structured interviews were conducted with a small sample of four students to gather an introductory experiential-based perspective from the actual students. They were undergoing the process of becoming ecoliterate. These students were randomly picked, but both cohorts that have undertaken the course of Design and Sustainability were represented. The paramount appreciation made by the students regarding their learnings from the course was how the consideration of sustainability in the defining process could be deeply ingrained into any project regarding its sector. All the interviewees believe systemic

thinking was now of their primary considerations when facing any design project.

■ Image 7. Main learnings collected in a mural at the end of the semester (2021 cohort)



Source: prepared by the author.

Additionally, the course results so far can be assessed against the growing interest that these undergraduate students are presenting regarding topic considerations for their graduation projects. Informally, the lecturer has been assessing and accompanying the different graduation project processes we chose somehow interlinked with sustainability and ecoliteracy.

■ Image 8. Main learnings collected in a mural at the end of the semester (2022 cohort)



Source: Prepared by the author.

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