



## Conceptual Designs for Sustainable Aesthetics: creative chess sets where form follows meaning

### Projetos Conceituais rumo a Estética da Sustentabilidade: design de jogos de xadrez criativos onde a forma segue o significado

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#### Abstract

The paper presents conceptual designs that explore the notion of 'sustainable aesthetics'. To encourage reflective practice through form and process, and guided by sustainable principles, a practice-based (thinking-and-doing) methodology was followed by Brazilian undergraduate design students. Beginning with a theoretical overview of the historical aesthetics of chess sets (premodern, modern and contemporary) the experimental findings show different approaches to thematic chess set designs that are guided by meaning-laden cultural considerations and developed using local, natural materials or reused (disposed) industrial materials. This is the first experiment of a project that represents a creative attempt to explore and develop an aesthetic for material culture through what we have termed a 'sustainable aesthetic function'. It demonstrates how objects with the same function can be expressed in very different ways whilst all adhering to the notion of 'form follows meaning'.

**Keywords:** conceptual design; reflective practice; aesthetics; sustainability; form follows meaning

#### Resumo

*O artigo apresenta projetos conceituais que exploram a noção de “estética da sustentabilidade”. A fim de estimular a prática reflexiva por meio da forma e do processo de design, uma metodologia baseada na prática e guiada por princípios sustentáveis foi aplicada com estudantes brasileiros de graduação em design. Partindo de uma visão teórica geral a respeito da estética histórica dos conjuntos de xadrez (pré-modernos, modernos e contemporâneos) os experimentos iniciais demonstraram diferentes abordagens na criação de jogos de xadrez temáticos. Carregados de significado e de considerações culturais, foram desenvolvidos utilizando materiais naturais locais ou materiais de reutilização industrial (descartados). Este é o primeiro experimento de um projeto que representa uma tentativa criativa de explorar e desenvolver uma estética para a cultura material por meio do que chamamos de “função estética sustentável”. Demonstrando como objetos com a mesma função podem ser expressos de maneiras muito diferentes, na medida em que todos aderem ao princípio “forma segue significado”.*

**Palavras-chave:** design conceitual, prática reflexiva, estética, sustentabilidade, forma segue significado



## Introduction

The chess set is part of the world's cultural history. Its origins date back to 5<sup>th</sup>-century India (BELL, 1979, p. 51) and it is known as 'the royal game' both because it has held a principal place among intellectual pastimes and because it was played by the royalty of medieval Europe. It is not surprising, therefore, that traditional chess pieces express this historical, hierarchical pedigree (WALKER, 2014, p. 118). Requiring involvement, concentration and a sense of fair play, it has a fixed goal and offers opportunities for social interaction and continual improvement (WALKER, 2014, p. 121). Unlike more passive forms of entertainment, some of which can foster addiction-like behaviours, the conventional game of chess can be understood as an “active-reflective” leisure activity.<sup>1</sup>

Over time, a wide variety of chess sets have been designed, incorporating a range of shapes and materials. Some are handcrafted in stone, ceramic, wood or, in former times, ivory, while others are mass-produced from metal, glass or plastics like ABS. The 19<sup>th</sup>-century *Staunton* chess set design (Figure 1) was created by the British designer Nathaniel Cooke who registered his design at the London patent office on March 1, 1849. Its increasing order of height expresses the hierarchical sequence of pawn, rook, knight, bishop, queen and king. Today, it is the most well-known chess set design and was adopted for international tournaments by the Fédération Internationale des Échecs (FIDE) in 1924. It allows players of different origins and language to play together without encountering problems identifying the pieces (FILGUTH, 2008, p. 158).



Figure 1: Staunton pieces hierarchy - most popular (official) model of chess set, designed by Nathaniel Cook, 1849.

Image by S. Walker

<sup>1</sup> In the traditional overview, we can say that individuals have an outer, active life and an inner, contemplative life. These ways of living may vary between a neglectful, unmindful and selfish life to a reflective one, enhanced by inner-reflection and selfless. By a “reflective-active leisure activity”, we can understand a kind of game that stimulates the individual to engage in self-examination and strive for understanding (WALKER, 2014, pp. 63-64).



In pedagogical terms, the aim of this paper is *to design a basic chess set in keeping with the ethos and principles of sustainability*. The creation of a chess set does not require high-energy production methods that contribute to waste or emissions. A chess set can be readily made from locally sourced materials using basic processes. Also, the designer's contribution lies not in changing the game, but in the creative development of its material form. However, it is important to recognize that this development and the decisions involved can have far-reaching consequences that relate to sustainability and are manifested in the aesthetics. This project explores these connections so as to better recognise the links between sustainability, aesthetics and contemporary economic, political and technological systems that are dependent on consumerism.

The act of designing a chess set can be guided, or not, by ethical and aesthetic values and meanings. When designers embark on the process, their intentions and values become embedded, and pre-established in the design brief before any creative work even begins.

The initial phase of this experiment began with an historical and theoretical reflection on forms and processes used in the creation of chess sets. Two different design briefs then led to the development of six thematic designs by undergraduate design students at the Brazilian Federal University of Uberlândia, MG.

Using either local natural materials or reused industrial materials, the values-based approach "progressive design praxis" (WALKER, 2019, pp. 268-293) was applied as an academic design methodology, which is defined as follows:

**Progressive Design Praxis** is a form of design practice that aims to change the situation for the better by striving to interpret, understand and apply the ethical values and notions of virtue found in the philosophical and spiritual traditions of one's culture (WALKER, 2019, pp. 268-293).

This interpretive approach is guided by meaning-laden cultural considerations and sustainable principles. It recognizes that objects with the same function can present contrasting forms as a consequence of different design planning approaches. As an exploration of "sustainable aesthetics" (PAPANÉK, 2014, pp. 268-72; WALKER, 2006, p. 186; THACKARA, 2008, p. 206; CROUCH, 2015, p. 17), the exercise consists of a reflective-critical process that leads to physical artefacts based on a principle of "form follows meaning" (WALKER, 2011). In this way, the act of realizing sustainability moves away from the modernist principle of "form follows function"; an ideology that has characterized the era of mass-production, consumerism, and also unprecedented environmental exploitation (PANTALEÃO, 2020).

### **Theoretical Reasoning: research questions and aesthetic inquiry**

During the early 20th century, design adapted to machine production and led to the "machine aesthetic" of modernism (BRUMMETT, 1999). In the current post-industrial period of digital information and technological, globalized society, the scope of design activities has been widened to include environmental and ecological concerns. Consequently, it is reasonable to consider the notion of "sustainable aesthetics" in relation to contemporary design.

Although many of the limitations of modernity have been superseded, late- or post-modern sensibilities have not yet evolved to the extent where the economy and natural environment are regarded as interdependent and equally important; more often, politicians regard environmental concerns as impediments to economic growth. Guided by brands and markets, which are primarily



the concerns of providers and customers, higher education, including design courses, are increasingly adopting the market model as institutions, and in their research support, ‘impact’ and ‘league table’ evaluations are used to evaluate research relevance, especially with respect to the economy, jobs and graduate success.

At the Bauhaus<sup>2</sup> in 1923, the modernist approach changed the direction of design and production, with the replacement of Johannes Itten’s<sup>3</sup> progressive educational practice (i.e. John Dewey’s “learn by doing”) by the constructivist methods of László Moholy-Nagy:<sup>4</sup>

It was at this time, according to Schlemmer, that ‘design for industry was born’.<sup>5</sup> Subjective expression, an intimate and direct knowledge of traditional materials, craft-based approaches, unconscious associations with the creative process and links between creativity and spirituality were all de-emphasized. Priorities shifted to the needs of industry, focusing on design for mass-production, materials technology and design for efficiency (WALKER, 2014, p. 117).

With this change, an approach based in creative liberty was supplanted by an emphasis on design for machine-based manufacture and economic efficiency. The Bauhaus legacy lives on and has been the single most significant influence on undergraduate courses in design. “Form follows function”, however, turned out to be nothing more than just another style, which became especially apparent when the Bauhaus philosophy was applied to electronic products. Even so, it remains highly influential but its minimalist aesthetics tend to celebrate newness and perfection, which is an impediment to sustainability (WALKER, 2014, p. 117).

Recognizing the continued influence of the Bauhaus, we must also ask how contemporary sustainability issues are to be addressed, what this means for aesthetics and is it possible to use this “aesthetic function” of design (GROSS/LOBACH, 2001, pp. 54-65) to build greater ecological awareness among design students?

Bearing in mind that design is concerned not with generalities but with specifics, we must refer to designed examples to try to answer these questions. Accordingly, an aesthetic inquiry was conducted that compared two chess set designs, with the aim of identifying specific differences in outcomes and approaches and thereby revealing the related design factors. The two chess set

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<sup>2</sup> A historical landmark of education and design activity, the **Bauhaus** was initially a school based in the city of Weimar, Germany, in April 1919. In the modernist period (first half of the 20th century), the institution aimed to teach more socially responsible artists, designers and architects. Although the Nazis closed the Bauhaus in 1933, the enforced emigration of its professors was responsible for spreading its ideals around the world (DROSTE, 2006).

<sup>3</sup> **Johannes Itten** (1888 - 1967) was a Swiss painter, writer and professor associated with the Bauhaus school. Invited by Walter Gropius (Bauhaus founder) to give a lecture on ‘*Teachings of the Old Masters*’ at the inaugural session of the Bauhaus on March 21, 1919. In October of the same year he held the Bauhaus professor chair until March 1923, when he resigned. For some, Itten was the most important figure during the first phase of the Bauhaus, especially in the organisation and structuring of design courses. He developed a preliminary course (*Vorkurs*), whose objective was to eliminate from the student's mind the prejudices they brought with them. Based on the belief that each person has a universal balance, his ‘*harmonization theories*’ aimed to make students look for their own rhythm in order to develop a harmonious personality (DROSTE, 2006).

<sup>4</sup> Influenced by Russian Constructivism and a defender of the integration between technology and industry in design and arts, **László Moholy-Nagy** (1895 - 1946), replaced Johannes Itten in 1923 as the instructor of the ‘preliminary course’ at Bauhaus, which effectively marked the end of the school's expressionist teachings, bringing it closer to its industrial design school goals (DROSTE, 2006).

<sup>5</sup> Cf. SCHEIDIG, W. *Weimar Crafts of the Bauhaus: 1919-1924/An Early Experiment in Industrial Design*. New York, NY: Reinhold Publishing Corporation, 1966, p. 26.

designs are the Bauhaus set by Josef Hartwig<sup>6</sup>, 1923/24 (Figure 2 left) and the *Balanis* set (Figure 2 right) by Stuart Walker, 2014:



Figure 2: Left - Replica of the Bauhaus chess set designed by Josef Hartwig in 1923/24. Image by L. Pantaleão  
Right - Balanis chess set designed by Stuart Walker in 2014. Image by S. Walker

The Staunton set (Figure 1) expresses the roles of the various pieces through their figurative designs and height differences based on socio-historical hierarchies. In contrast to these cultural references, Hartwig's design exemplifies the 'form follows function' ethos through its minimalist, modernist aesthetic. In tune with the spirit of the age, Hartwig made the forms indicative of their respective movement on the board (i.e. their function), and eradicated much of the hierarchy. In so doing, the design alludes to the egalitarian principles advocated by functionalism. With their predefined geometric designs, the pieces can accurately reproduced by machine. Prototyped in pear wood and stained pear wood, natural forms and textures are eliminated. In keeping with the international style of mass-produced good, cultural distinctions and traditions are eliminated. Hartwig's design is an excellent example of the Bauhaus philosophy. It is a formal expression of its highly rationalized approach to form and function (WALKER, 2006, p. 117; WALKER, 2014, p. 125).

In the wake of the modernist principle "*less is more*", attributed to Mies van der Rohe (whose intention was an honest and democratic approach), the constraints imposed by machine tools meant that modernism excluded virtually all references to pre-modernist styles and ornamentations:

Fundamentally, the Bauhaus school, at least in its latter years, was geared towards design for mass-production and, in creating designs for this type of manufacturing it sought a universal aesthetic by emphasizing rationalistic approaches, simplifying form, rejecting decoration and abandoning convention; and we see all these traits expressed in the mass-produced products of today that are aimed at global markets. With these developments, aesthetic references to tradition, which can contribute to cultural continuity and are often deeply meaningful, were actively stripped away (WALKER, 2014, p. 116-17).

<sup>6</sup> German sculptor, **Josef Hartwig** (1880-1955), was head of stone and wood sculpture at the Bauhaus between 1921 and 1925. In 1923 he designed the Bauhaus chess set. After the closing of the Bauhaus he worked until his death as a master at the Frankfurt Municipal Gallery sculpture restoration workshop (DROSTE, 2006).

In contrast, the intention of *Balanis* design was to integrate aspects of modernism, especially the simplified forms, with aspects of the traditional figurative/height characteristics of the Staunton set, while also taking into account contemporary sustainability principles, particularly use of local, natural material, low-energy processes and human skills. It is made from locally-sourced, wind-fallen branches of a holm oak (*Quercus ilex*) and natural flax – both as flaxseed oil and flax cord. By employing simple and quiet processes, the chess pieces were made without accurate measurement; lengths and angles were determined by eye. To minimize the intervention and maintain a closeness to the natural environment, the bark was preserved. By using few tools and specialized skills (cross-cut saw and sandpaper), which take into consideration the characteristics and quality of the labour required, the cut branches were given a light sanding to remove rough edges and bring out the end grain. Flaxseed oil was applied to seal and protect the wood while maintaining its natural qualities and attributes. Flax cord binding differentiates the two opposing sides (WALKER, 2014, pp. 122-124). Thus, the design accords complements the materials and processes in that each piece is defined by just one cut of the saw – the variations in height and angle of cut being enough to differentiate each piece.

Last, but not least, its name *Balanis*, refers to cultural associations of the wood type. This species of holm oak is not native to Britain; it was introduced from the Mediterranean in the 1500s. In its native lands, the ancient Romans valued it for its functional qualities, especially its strength and durability (practical meanings). For the ancient Greeks, its evergreen leaves were used to tell the future (symbolic/social meanings) and in Greek mythology, *dryads* or wood-nymphs inhabited the trees, and lived and died with them; the dryad of the holm oak is *Balanis* (WALKER, 2014, p. 123).

Rather than attempting to control nature and force-fit it the material into a predetermined design, the *Balanis* design is in keeping with ways of being and doing that flow with and yield to the warp and weft of nature. In minimizing the intervention, the form of each piece becomes a function of nature's forms and this is apparent in the designed outcome (WALKER, 2014, p. 126).

Regarding comparative design inquiry, the purposes, methods of making, materials acquisition and transformation, aesthetic expression, and the overall meaning is summarized as follows (Table 1):

Design factors	'Hartwig' chess set design for industrial production	'Balanis' chess set design for sustainability
Materials	Selected on suitability for purpose. Materials are based on their ability to achieve the specifications of a predefined design. Prototype in pear wood and stained pear wood.	Selected on availability for purpose. The design emerges by considering the particular qualities of an environmentally responsible, local material. Created from discarded, wind-fallen locally grown holm oak, with flax cord binding.
Form	Purely functional: expressive of its movement on the board.  Formal differences in stature have been reduced, in line with modernity's emphasis on egalitarianism.  Indications of rank via figurative forms have been eliminated. Differences here are indicative of the role and	Retains the character of the branch from which it came. Pieces are differentiated through height, girth and angle of the upper face.  Formal differences in stature are indicative of identity and rank, in acknowledgement of the game's traditional form and aspect.  Indications of rank via figurative forms are absent in recognition of modern sensibilities. Rank is indicated



	contribution of the piece in the game, and are in accord with meritocratic values.	through stature, combined with upright aspect and cut angle, in recognition of the game's rich history.
	Standardized for mass-production and large markets – resulting in forms that are not specific to or reflective of any particular place.	Particularized through local production for local use – resulting in forms that are specific to and reflective of place, i.e. via local wood and 'raw' aesthetic.
	Machined, exact, geometric, uniform, repeatable.	Natural, irregular, organic, varied, unique.
	Anonymous, universal, instrumental, mass produced, narrow form-follows-function.	Appreciative, located, intrinsic, one-off, holistic, form-follows-meaning.
Tools and making	In design for industrial production, which the Bauhaus was exploring, the pieces are accurately machined into predetermined shapes. Precision machine tools are required, necessitating that their manufacture, shipping and use draw on energy supplies, cause emissions and require eventual disposal.	The shape of each piece is determined partly by nature and partly through selection of the natural branch. Variations in height and angle of cut, both determined by eye, create formal differences between pieces. Tools required are minimal – a cross-cut hand saw and sandpaper.
	Controlling, energy-intensive, polluting, noisy, wasteful.	Yielding, low-energy, clean, quiet, prudent.
Finishing	Natural forms and textures have been completely eliminated.	Natural forms and textures have been largely retained.
Design <i>ethos</i>	The shape of each piece fits within a rationalized system that governs the relationship of form to function.	The shape of each piece is partly natural, partly imposed, and is a function of a particularized response to natural elements.

**Table 1: A comparison of the design factors in the Hartwig and the Balanis chess sets (WALKER, 2014, p. 125)**

In comparing the Hartwig and *Balanis* designs, we can say that the Hartwig design attempts to synthesize general ideas about modernism and express them through the pieces of a chess-set, whereas the *Balanis* design represents a contemporary attempt to conciliate broader and inclusive concerns of that marry historical and cultural traditions with sustainability, including considerations related to the natural environment, social equality and localized economy (WALKER, 2014, p. 126).

Today, if we consider the urgency of ecological challenges, the modernist idea of 'less' is still 'a lot'. To point to more holistic paths that aim to manifest the fundamental ethos of sustainability, this aesthetic inquiry demonstrates that artefacts for human use are capable of expressions that are representative of more subtle directions that are less invasive of nature. It is design *with* nature. It is also design *for* people – employing local people, hand skills, natural materials and creating good work. This contrasts with much modern design that strives to conquer nature and regards people as a liability, which can be overcome by fewer jobs and greater automation.

### Materials and Methods

Contrary to how it is often interpreted in academia, design research need not and should not be limited to design scholarship or scholarly research. Practice is a critical ingredient of design that involves an integrated, inseparable process of thinking-and-doing and imparts tacit knowledge and experience. It demands 'seeing' what and how to do, invokes the imagination, and

builds skills; none of which tend to be nurtured or valued in the predominantly rationalistic approaches of conventional scholarship. Practice is a way of investigating, exploring, expressing and learning and is fundamental to the arts. Therefore, we take the position that design research can also be characterized by a purposive, creative process of thinking-and-doing and is not limited to the scope of rational knowledge (WALKER, 2013, p. 447).

In the sense of opening up imaginative ways for inspiring ethical values and cultural meanings, this paper applied theoretical-historical reflections to guide a methodology based on practice. The development of a chess set design oriented towards sustainability is progressed through the thinking-and-doing creative process. The experiment was developed in person (prior to the COVID-19 pandemic) with students of the Faculty of Architecture, Urbanism and Design at the Federal University of Uberlândia, MG, Brazil (FAUeD/UFU).

After twelve weeks of preliminary theory, methodology, history, and cases studies, including do-it-yourself exercises, the following design approach was developed over the preliminary period called Project I (two 3-hour sessions per week for four weeks). The class comprised thirty-seven first year students, democratically organized into groups of three or four students who opted to work on either briefing A or B, as shown in Tables 2 or 3:

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**BRIEFING A**

Intention (purpose)	To design a thematic chess set (pieces and board);
Target users	Brazilian teenagers of both genders: students, sports players, users of games and other electronic entertainments (e.g. social networks, smartphone apps, TV series, etc.);
Materials and making	Selected by availability and purpose. <b>Natural materials of local origin</b> and simple processes not harmful to the natural environment.
Form	<b>Distinctive artefact</b> ; Hand-scale dimensions;
Design <i>ethos</i>	<b>Each piece must be partly natural, partly imposed; in a ‘response-ability’ to particularized (handcrafted) production.</b>

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Table 2: Briefing A – Design with natural materials for small-scale (handcrafted) production

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**BRIEFING B**

Intention (purpose)	To design a thematic chess set (pieces and board);
Target users	Brazilian teenagers of both genders: students, sports players, users of games and other electronic entertainments (e.g. social networks, smartphone apps, TV series, etc.);
Materials and making	Selected by availability and purpose. <b>Reused materials that are locally available</b> and simple processes not harmful to the natural environment.
Form	<b>Repeatable prototype</b> ; Hands-scale dimensions;
Design <i>ethos</i>	<b>Each piece must fit within a rationalized system; to favour serial (small-scale batch- or open source-) production and distribution.</b>

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Table 3: Briefing B – Design with reused materials for serial (industrial) production

Designing progressively and relatively slowly, but with diligent decision-making, the process was supervised by the professor on a weekly basis. In Week 1, students carried out web-based research to develop their theoretical arguments about the potential educational benefits of the



game of chess. They also needed to compile a list of locally available materials, along with visual references (images) of different chess sets that could be inspiring for the project. In Week 2, students gave two group presentations: one to present the data obtained and to reflect critically on a theme to be selected, and the other to ideate and define a way forward for the design. Week 3 was dedicated to developing and prototyping the artefact. In Week 4, the students tested and video-recorded their chess set design in use, presented it to other students, and explained their process.

These methodological steps were guided in order to alternate the two facets of learning. Weeks 1 and 3 prioritized divergent, synthetic, intuitive, holistic and spatial thinking – associated with the right-brain hemisphere – which tends to characterize the artistic method and is related to the understandings of the private moral sphere. Weeks 2 and 4 weeks prioritized convergent, analytical, rational, linear and numerical thinking – associated with the left-brain hemisphere – which tends to characterize the scientific method and the intellectual investigation of the natural world (PANTALEÃO and PINHEIRO, 2009; WALKER, 2017, pp. 98-101).

### Experiment Findings and Discussion

Among the nine artefacts developed by the students, six are presented here, illustrating findings from both briefings. Figures 3, 4 and 5 express the ideas of a creative search using local natural materials and a handcrafted process i.e. Briefing A. Figures 6, 7 and 8 reflect a search of local reuse and waste materials for repeatable design (for industrial and/or open source production/distribution) i.e. Briefing B. The artefacts are accompanied by a short description of the materials and techniques employed, including the meanings of the themes chosen by the groups, and their respective authorship.



Figure 3: Brazilian Cerrado animals (2019)

**Briefing A: Example 1:** Developed by Alisson Ambrosio, Diana Hu, Felipe Picioli and Julia Lemo. The board (Figure 3) is made from a found piece of *Tamboril* (*Enterolobium maximum*) - a very light wood commonly used by Brazilian Indians for their river boats. The chess pieces are made from local natural clay and coloured with *Tupi-Guarani*<sup>7</sup> indigenous natural pigments made from seeds, called *Urucum* (*Bixa orellana*) for red and *Java plum* (*Syzygium cumini*) for purple. The theme is Brazilian *Cerrado* animals, representing the biome where the university is located.

<sup>7</sup> The indigenous people called *Tupis-Guaranis* are one of the most populous among more than 300 indigenous people who lives in Brazilian territory. They are one of the first peoples who had contact with European colonists in Brazil in 1500, and they still live mainly in the southern region of the Atlantic Forest. Much of Brazilian Portuguese vocabulary was “borrowed” from their language, especially to name local fauna and flora; e.g. names related to fishes, birds, mammals, herbs, roots, seeds, woods, divinities and some Brazilian cities.

The hierarchical differences are reflected in the height of each piece. Despite their dedicated efforts, this group reported difficulty in mastering the modelling technique, which is understandable, but naturally compromised the quality of the final forms.



Figure 4: Brazilian ('Atlantic') animals (2019)

**Briefing A: Example 2:** This design (Figure 4) also takes the fauna as its theme, but here the students, Felipe Nielsen, Felipe Nunes, Giovanna Martins and Nayara Miranda represent Atlantic forest animals. The chessboard has a wooden base, with the alternating squares created with glued sand and soil and decorated with leaves, small stones and seeds. The pieces are modelled by hand using local natural clay and coloured with water-based paint. The animals were chosen based on colour, e.g. Red Macaw (*Ara chloropterus*) versus Yellow Macaw (*Ara ararauna*): same genus, different species. Despite being supervised, this group failed to deepen their research and seek technical advice on biogeography. Consequently, they confused both the zoological classification and geographic distribution of some species.



Figure 5: Mythology Signs (2019)

**Briefing A: Example 3:** Employing a minimal intervention, Julia Spohn, Maria Eduarda Fernandes, Noêmia Campos Claro and Ygor Bento Guimarães decided to expand their creative freedom with respect to *meaning*. This set (Figure 5) explores the theme of mythological signs. The board is made from a raw cotton, chequered with a pigment prepared from coffee powder; it doubles as an eco-bag for the game pieces. The pieces are stones. The black stones are used in abundance as a raw material in the building industry. The white stones are calcite, a carbonate crystalline mineral common in sedimentary rocks, which were carefully picked out from the heaps of construction gravel. Mythological symbols are inscribed on the pieces, which serve to differentiate the two sides, and this is accompanied by a legend about the meaning and hierarchy. Considering that the city of Uberlândia has its own traditional weaving centre representing social and cultural heritage, it was suggested that the students consider using a cotton fabric made locally by hand, as a future proposition. It was also felt that the use of graphic symbols rather than form to differentiate the game pieces could be confusing for players.

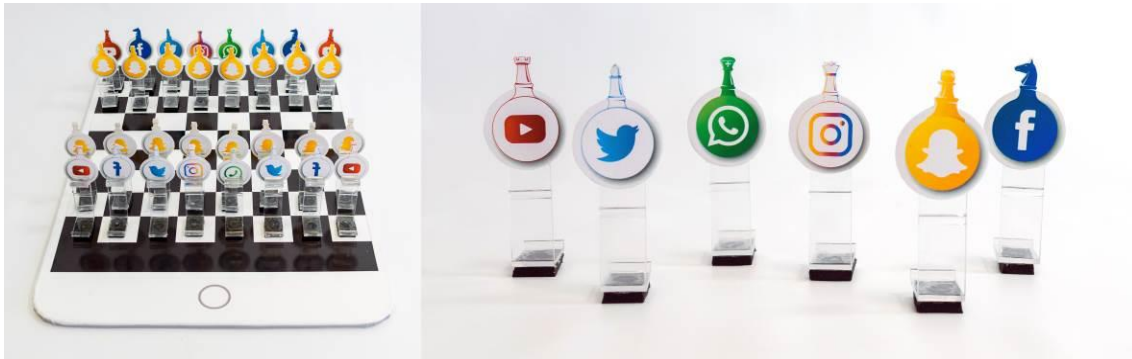


Figure 6: Social media complex chess set (2019)

**Briefing B: Example 4:** Using the theme of social media, technology and complexity, Humberto Guedes, Giuseppe Iannarelli, Mirilayne Sabino and Eduarda Caxito transposed symbols of from the digital sphere to physical form (Figure 6), using large-scale discarded materials. Created in the format of a smartphone, the game board is made from scrap galvanized zinc sheet; a commonly material in Brazilian construction, used for roofs and walls. The pieces are made from discarded printer cartridge seals (clear acrylic) and discarded refrigerator rubber. The surfaces of both game board and pieces are printed adhesive paper waste. The hierarchy is defined by graphic symbols in the top of the botons (pieces).



Figure 7: CPU Hardware (2019)

**Briefing B: Example 5:** Created from CPU hardware waste, students Izabela Evangelista, Laura Procopio, Vanessa da Silva and Waldyr Morais developed this fifth chess set design (Figure 7). The game board is created from discarded motherboard, framed in wooden slats and covered with discarded acrylic. The pieces are created from precisely selected castoff keyboard parts. Differentiated by coloured ribbons, the selected keys indicate their hierarchy: expendable small keys (F1 to F8) are the pawns; the letter ‘T’ represents the towers (rooks); ‘X’ and ‘L’ symbolize the movements of bishops and knights; and Control key and Operational System key are the queen and the king respectively. In this example, while the game piece differentiation again relies only on graphic symbols, in this case, the simple logic of the symbol hierarchy is more intuitive.



Figure 8: Deck of Cards (2019)

**Briefing B: Example 6:** The final design (Figure 8) explores the theme of playing cards. Juliana Faria, Viviane Aiko, Victoria da Silva and Rodrigo Sousa wanted to have fun with two different kinds of play sets. The chess board, made from a piece of reused MDF, has a large playing card painted on both sides. MDF (Medium-Density Fibreboard) is wood-based sheet composite used by the Uberlândia furniture industry and in construction and other applications. As a material, it presents one of the greatest challenges for local sustainability due to the excessive amounts being discarded, around 300 tons every month, and the material's toxicity due to urea-formaldehyde resin in its composition. The chess pieces are also made from waste furniture industry components. They are pieces of threaded bar sawn into hierarchical heights and identified by different configurations of nuts and other threaded elements. Despite the availability of the various parts and their ability to allow different configuration, there was a technical problem. The ratio between thickness and height of the chess pieces makes them unstable. A proposal was suggested to these students to resolve this.

It is important to note that the students who actively participated in the weekly supervisions deepened their reflective capacity and consequently created more satisfactory results, especially in relation to the conceptual coherence between intention and aesthetic form. This generation of students identifies with the maker movement. Due to COVID-19, in 2021 we are repeating the experiment online with students working alone at home. In future, when it becomes possible, we intend to repeat the experiment in the studio, but give it a longer period, to allow more effective collaborations with disciplines such as biology, anthropology, philosophy, computer science etc., as well as closer guidance by student monitors and local artisans. We also intend to repeat it with a group of senior students to compare findings and see how their abilities and skills advance. The fauna and flora theme seems especially fruitful and could be investigated further.

### Final Considerations

Usually defined as a professional activity, industrial design aims to enhance the effectiveness of product function, appearance and value for users and manufacturers. Its constant concern to satisfy economic demands often eclipses ecological considerations as well as more creative, less conventional practice-based design research. Industrial design, and business in general, commonly designate people as 'consumers'. In contrast, craft is concerned with creating one-off or limited edition objects that exhibit refined skills and which may or may not be wholly functional. Concerned with creating meaningful and/or collectable objects, the artefacts of skilled makers are often more poetic, with an inherent beauty and tactility due to the materials and the care in their making. Sometimes regarded as *objets d'art*, craft can be understood as an antidote



to mass-production, where the time, ‘response-ability’ and meaning invested in the process are part of its value. These differences and contradictions are inherent to sustainability and require careful consideration. They pose particular design challenges, especially with respect to materials, process, tradition and place. One of these challenges, with regard to sustainability, lies in the continuation of our current design approaches (WALKER, 2011, pp. 190-191).

Through divergent ways of ‘thinking-and-doing’ regarding our material culture, this paper has presented tangible results from an academic design project for first year design students. Looking beyond conventional industrial design and beyond contemporary craft, conceptual designs can offer inspiring possibilities that challenge prevalent instrumentalism and functionalism. Regarding the dialectic of form and function, personal meanings are capable of reconciling imaginative-rationalistic, subjective-objective divisions, leading to a more holistic vision for design. Seeking a more harmonious moderate approach that fuses ‘aesthetic function’ with ‘practical function’ becomes possible through ‘symbolic function’ (PANTALEÃO, 2020, pp. 23-24). In this way, subconscious associations, and inner and direct knowledge typical of the creative process, naturally inspire reflective-critical aesthetic expressions. These, in turn, can begin to manifest and legitimize a ‘sustainable aesthetic function’ in which form follows meaning.

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