Rethinking colour in design education through the human and social perspectives

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The issues of colour education concerning the lack of consideration of this subject in creative and project disciplines' curricula have been documented by several scholars during the last 30 years. In the case of design, apart from the fact that colour is not taught or is taught very little, one of the main problems is that the few courses that teach this subject are structured almost exclusively based on colour theory and do not consider the application of colour to real and current design problems. One of the consequences of this is a lack of a culture of colour in design; the scarcity of training instances related to it in terms of specialised courses at the university level contributes to the lack of qualified professionals who know how to tackle colour design with the necessary skills. This article proposes to improve the teaching of colour for the design of the 21st century from a different approach: from content-centred education to human-centred learning. Six directions for colour design education are proposed and exemplified by placing the human being and the social perspective –the growing dissemination of ethical and social concerns – at the centre of the focus, a path that the design discipline has taken in recent years.

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Introduction

Despite the high relevance of colour in the design practice, the reality shows that the teaching and learning of colour in design and project or creative disciplines are far from being consolidated. In recent years, several scholars have indicated a lack of proper colour training within design and architecture faculties[1]. Some researchers have investigated the presence of colour courses in design and architecture programmes and have found that colour is critically under-considered. For instance, Bantom [4] evaluated 96 interior design programmes of the U.S.A. and Canada, finding that only half of them considered colour knowledge, and many issues in how colour was being taught. Minah [6] states that in schools of architecture and urban design in the United States, colour is rarely a subject of serious inquiry in the design studio. Motamed and Tucker [9] performed research of design programmes in the United Kingdom, Australia and Iran, revealing that colour has been dropped from the core curriculum of the majority of schools in these locations. Csillag *et al.* [13] informed about the situation in Brazil by reporting that less than 30% of design courses in São Paulo have explicit colour content, where only 18,5% of fashion design courses teach colour as a separate subject. This situation can be easily found in other countries of Europe, Oceania, North and Latin America.

[1] See the studies of: Smedal and Svedmyr [1]; Janssens and Mikellides [2]; Durão [3]; Bantom [4]; Gamito and Moreira [5]; Minah [6]; O'Connor [7]; Jung [8]; Motamed and Tucker [9]; Witcher [10]; Weber and Kanthak [11]; Arnhil and Pyykkö [12]; Csillag *et al.* [13]; Hirschler *et al.* [14]; Mottram [15].

When colour is taught, one of the main problems found is that courses mainly focus only on colour theory, leaving aside content concerning colour application in design fields. According to Bantom [4], in many cases, the lectures and assignments do not go beyond theoretical knowledge, such as the colour wheel, colour harmony and colour systems. This fact is confirmed by other scholars [16-18]. Additionally, this knowledge of colour theory, undoubtedly essential, in many cases has not been brought up to date with the current needs of the design discipline [7, 19], with concepts being outdated for more than a century. To better understand the impact this situation may have on the people or individuals involved, i.e. the human factor of it, different studies have performed surveys to the main actors of the issue of colour education for design - namely design professionals, students and teachers. An integration of results from those and new studies together with the actors' experience is presented here.

The issues of colour education according to stakeholders

Design professionals

When asking designers and other creative professionals, in the first place, many of them have a high appreciation for the importance of colour within the design process [4, 20]. Designers usually indicate that colour should be integrated from the beginning of the process, in the design development and idea generation phases. In Smith's survey of 16 interior designers and architects [20], the majority of them indicated that colour was highly relevant for the perception of space, building form, way finding, ambience and image. For 69% colour was a major consideration when they were beginning their training as designers, although in that moment, only a few of them used colour for developing concepts, colour selection, or colour schemes, but rather only as an aspect in which they could feel free to express themselves. In addition, most of them indicated that colour can be as a design tool that is 'practiced' rather than 'spoken about'.

Regarding colour education, design professionals indicate that designers should be educated in colour and they all would include at least one colour unit both in architecture and interior design courses [13, 20], and that the time dedicated to colour in their training was not enough, colour was not correctly taught or teaching methods were not effective or applied [21]. On the consequences of this lack of proper colour education in designers' formation, professionals often see colour work as a task that junior designers or new graduates could undertake [20]. In other cases, colour decisions are often designated to others who are more expert, or have to be approved by senior designers or design architects (ibid). Also, because of poor training in colour matters, most of them use colours based only on their intuition, on colours they 'think that work' or on personal preference [21-22]. In addition, some designers declare they learnt colour outside of formal education through individual research, internship or personal experiences, but when tested on their colour skills, only a few of them answer correctly to colour challenges [10, 21].

Design students

Studies have shown that design students, when beginning their educational programmes, arrive with significant expectations regarding colour training. They perceive the importance of colour in their education, including colour research [2, 4, 16-17]. They expect to be trained in colour through a variety of traditional and objective methods and demand the integration of theory and practice with real-life design tasks [12, 17]. In a survey among students from Sweden and the UK [2], they reported clear

differences between expected and received colour education, with most of the final-year students stating that very little of their education actually focussed on colour. The majority of students consulted on these studies would recommend including colour in a design curriculum.

According to Bantom's research among trainees of 96 interior design programmes of U.S.A. [4], students rely heavily upon personal preference when selecting colours. They assign great importance to colour in terms of aesthetics (e.g. decoration, ambience) but less importance in terms of function (wayfinding, building form), and only half of the students dedicate time to developing a colour concept (4 p.13). Half of the students incorporate colour in the design conception phase or first stages of design. This is also confirmed by other studies [23-24] while other scholars indicate that for most students, colour considerations are dealt halfway through their design process [2] or in later stages. In the case of students with specialised colour education, they learn that colour design is based on much more sophisticated principles than the designers' taste. Indeed, students who have received colour training mention a significant number of colour criteria as the design phases increase in complexity, commenting on the interrelations of one criterion with another; such as preference and symbolic-emotional knowledge, showing that the students' analytical abilities increase in time through colour education [17].

Some of the consequences of the lack of proper colour education of students regard the fact that even upper-level design students may struggle to explain the differences between the CMYK and RGB colour models, and much less have a confident command of colour both aesthetically and pragmatically [10, 16]. Additionally, it has been informed that students do not often seek outside sources for colour information, and only a few people attend to a colour course outside of the design school [2], demonstrating little effort to obtain colour training elsewhere or afterwards. If the importance of colour knowledge is not impressed upon students in their schooling, it may not be an area they choose to explore further as practicing designers [4].

Design teachers

The few studies found in the literature review regarding colour teachers refer actually to art teachers, who also struggle with the situation of colour education. After consulting the colour teachers, Howard [25] identified three main difficulties for teaching colour from the instructors' perspective, that may apply also for design teachers:

a. isolation: many colour educators work separated from colleagues by distance or discipline, or in a non-collaborative setting where they are the only instructors dedicated to the matter;
b. shortage of resources and time: only a few teachers are able to devote more than a few hours to the teaching of colour. Frequently the interdisciplinary nature of the subject relegates colour to brief, disjointed units taught in several different courses. Teachers usually deal with conflicting terminology and concepts, without adequate knowledge or resources. Many colour educators have only limited knowledge, much of it is superficial or outdated, gained when they were students from their own teachers;
c. educational materials: a limited number of countries have been able to coordinate the production of materials for colour education. Didactic materials about colour have high costs and educational institutions usually work on a limited budget.

In 2020, a workshop [19] with colour teachers from design institutions of different countries–North America, Europe and Oceania–confirmed some of Howard's identified difficulties, and raised other issues: the shortage of time was still the most nominated by teachers (50%), followed by the lack of

teaching materials (25%) and sharing the third place we find difficulties regarding the complexity of colour knowledge (10%) and the inadequacy of the teaching physical environment and equipment (10%). Additionally, teachers provided feedback about when to teach colour within the design process' education, stating that colour should be included at the beginning of the design process, this is, starting from colour and form together, as this would have a big impact on the value that students will give to colour. Also, teachers referred to the fact that colour is usually approached only from a theoretical point of view, and not connected to the design practices, as teachers often do not have the time, the bibliography or the field experience to make these connections with the professional practice.

Shifting from colour theory to colour practice

As seen from the stakeholders, the lack of colour education through applied knowledge in design results in a lack of connection of colour theory and knowledge with current design discipline needs, which seems to be a constant element perceived by most actors. This issue has been also confirmed by a study to 103 colour courses for design taught during 2010-2020 [19], which inquired, among other elements, on the nature of the content declared in the courses' syllabi. The research highlighted the highly theoretical focus of the courses (with most contents relying on colour fundamentals), and that when practical activities were considered, these did not necessarily link the contents with real disciplinary work, but rather to basic exercises about colour mixing and visual composition. The research also showed that most of the courses are not focused on reflection or critical design thinking related to colour, meaning that students were not being sufficiently trained to master the interrelationships of the elements of colour (conceptual knowledge) or to develop a more advanced strategic understanding of how to work with colour in the context of design (metacognitive knowledge).

The consequences of this situation, according to scholars, is that students may feel a lack of confidence in using colour conspicuously in design practice [9], as they may not reach the basic academic skills for a satisfactory use of colour [21]. In addition, colour decisions often appear only in the final phase of the design process, and the reasoning for colour choices is almost never questioned [6, 8]. Proserpio and Vezzani [26] go further, pointing out that the lack of a culture of colour in design, the scarcity of training instances related to it in terms of specialised courses at university level, contributes to the lack of qualified professionals who know how to tackle colour design with the necessary skills.

In the view of the complicated situation of colour education, some researchers comment on how it could be improved. There is a general agreement on the fact that colour should receive greater emphasis in education for its own sake [4, 27]. Scholars also refer to the fact that colour theory should be reviewed and updated according to current design education needs [7, 10, 19]. Still, on colour theory, it should never be presented alone: colour courses should be entirely dedicated to the production of chromatic design projects and theory should be taught together with its application for each project [13, 28]. A systematised colour knowledge for design must be provided to students so that colour may become a more robust and defensible part of the design process [9].

All of the above indicates that currently there is no focus on the production of design disciplinary knowledge when teaching colour, only on the repetition and application of colour knowledge useful for design. This could be seen as a missed opportunity, as students might see colour courses or colour lessons as just another subject to be learned, rather than as an active field of disciplinary knowledge creation, the mastery of which could provide them with specialisation and differentiation in the future professional work. There is a strong need to move from a colour education based 'only' in the

transmission of theoretical contents (i.e. a content-centred subject) to a practice-based learning with a human-centred focus, which could motivate the production of strategic colour knowledge from and for design current and future needs. Getting acquainted with colour theory is only a starting point for colour education. Design educators, therefore, need to teach more about the use of colour in practice in commercial, industry and technological applications [10].

What practice? Designing with a human-centred focus

Until the 1980s, the design discipline had a strong product-centred focus, where a technical perspective had given way to a concern for users and their experiences. In the context of this paradigm shift, the Human-Centred Design (HCD)[2] approach emerges, as the product-user interaction takes place in situations where users' cognitive and emotional states will influence the interaction itself. Human-centred design is a problem-solving technique that puts real people at the centre of the development process, enabling you to create products and services that resonate and are tailored to your audience's needs [30].

> *Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance. [31]*

Human involvement is recommended in context documentation, research, iterative development of concepts and design solutions, implementation work and evaluation. Designers need to take up the challenge of encompassing the subjectivity inherent to human beings into the design process [32]. Putting humans at the focus and increasing user participation in the design process can garner a more comprehensive understanding of the design issues, due to more contextual and emotional transparency between designer and participant [33].

The social perspective of design

Together with the HCD focus, in recent years it has become imperative for design discipline to reflect not only on the single user but also on the social perspective, as defined by Rampino [34], a growing dissemination of social and ethical concerns. This is also affecting the design discipline as, since the very beginning of its history, it has been involved in shaping the artificial world we live in and the way we behave in it. While designers' social responsibility remained in the background for over a century, it has now moved to the foreground. The potential for fostering more sustainable user behaviour is a growing field of interest, together with a need for a careful evaluation of the ethical issues related to designing smart objects capable of taking autonomous decisions. These social and ethical concerns should also be of interest when working with colour, as it is a fundamental resource to build communication with users in product design, through marketing and appeal.

[2] For a more complete overview of the Human-Centred Design approach, see [29].

Teaching colour for design from human and social approaches

Thinking on the future of colour education for design with a human-centred and social approach, the different interrelationships of the human experience of colour must be considered. As proposed by Mahnke [35] these interrelationships start from the biological reactions to colour stimuli; they consider also conscious and unconscious–individual and collective–colour symbolisms and associations; the cultural influences along with those of fashion, style and trends; and arrive to the personal relationship with colour i.e. colour preferences. The way humans access to colour is through visual perception, so designers must be aware of the phenomena that influence the appearance and appreciation of designed objects. For instance, in a world always aiming for greater inclusion, it is necessary to reflect on how accessible the colours of our product are, when more than 300 million people in the world have some degree of colour deficiency [36]. Additionally, considering users collectively must also take into account the psychological characteristics of chromatic phenomena, as different groups of people will react differently to colour. And also, we have seen how ethical and social concerns about colour must be taken into account as design is moving towards that direction.

From the above, six contemporary design perspectives are presented below in the shape of directions for teaching colour as more aligned to the current and future design discipline needs:

i. (Colour) Design for Sustainability: aims for net-positive impacts, namely beneficial outcomes for society and the natural environment. Designing sustainably means having a sense of responsibility and, above all, creating a synergy among human beings, the health of the planet, and economic prosperity [37]. Teaching sustainable colour design means (a) carefully considering sustainable colour applications; (b) designing for colour lifecycles; (c) selecting colours with a sustainable and appropriate lifespan; (d) recovering colours from waste materials that may lead to experimentation that combines science and art; (e) highlighting the value of visible recycled colour; and (f) fostering concrete actions related to understanding how to reuse, recycle, and recover colours. All of these actions should stimulate reflection and critical thinking in students.

Image 1: Circular Cup is one of the first products to transform materially complex used coffee cups into long-lasting products.

ii. (Colour) Design for Health and Wellbeing: offers a perspective for designers to understand the complexity of healthcare systems, to identify the needs and expectations of the different stakeholders, and to design innovative and sustainable solutions with an added value for human health. Teaching colour for health and wellbeing should address some considerations regarding accessible design, visual ergonomics and colour wellbeing, as they may be relevant when thinking on specific groups of users and colour may have different effects for children, adults or elderly people[3]. This approach asks students to look for solutions that are part of sociotechnical systems, needing a holistic view on the colour design process and working in multidisciplinary collaboration.

Image 2: Leicester Children's Hospital interior design created by AFL Architects has won several prices for its colourful and friendly atmosphere.

iii. (Colour) Design for Behavioural Change: concerns designing products and services with the aim to change people's behaviour. Design interventions often support people to create awareness and help them either realise an intended behaviour or maintain a preferred behaviour. Teaching colour in design for behavioural change raises ethical questions concerning colour and colour application. It inquiries into the ways in which communication through colour persuades or dissuades human behaviour. An example of this could be thinking critically about the impact of consumer culture and colour trends, which generate more waste and exploitation of the planet's resources yearly, and how we could modify those practices.

[3] Some references to review in these matters are: on colour wellbeing [38-39]; on colour wellbeing for the elderly [40-43]; on colour wellbeing for children [44-45]; on colour design for healthy environments [46-49].

Image 3: The 3D zebra crossing is an urban intervention that emerged in India. It creates the optical illusion of an elevated pedestrian crossing, stimulating cars to slow down as they approach.

iv. (Colour) Design for Emotion: is a perspective on design that takes the intended emotional impact as the leading principle in the design process. In his book, Emotional Design, Norman argues that the emotional side of design may be more critical to a product's success than it's practical elements [50]. It offers a systematic approach to designing products with predefined emotional intentions. Teaching colour in design for emotion means taking into account how colour can affect the emotional responses of people regarding the appearance and communication of objects and spaces and the interaction of the user with the design. Observing, measuring, creating and evaluating those emotional responses to colour may help to determine users' concerns. Colour in design may raise people's expectations and beliefs about how themselves, other people, and objects and products should behave or act.

Image 4: Always preoccupied with transmitting emotions, the creative team of Lexon designs beautiful and innovative everyday emotional objects.

v. (Colour) Design for the Majority: means designing products and product-service systems for the world's less fortunate people. Often these people live in nations with emerging markets that are characterised by rapidly growing production and consumption. When teaching

colour design for the majority, we need to consider implementing the question of colour within participatory methods, collecting information about local colour meaning and perceptions of value, and working with affordable and accessible colour production costs for the intended users. For instance, embracing local colours and local identity, can positively shape perceptions of territory and create reconnections with the land and landscapes. These actions could foster relationships with communities by linking regional colour to local manufacturing.

Image 5: The Favela Painting Project was developed by Jeroen Koolhaas and Dre Urhahn from the idea of creating community-driven art interventions in Brazil.

vi. Culture-Sensitive (Colour) Design: is a perspective that highlights the influence of culture regarding a designer's background, the process of designing, and the generated designs. A sensitive eye for the cultural affiliations (i.e. shared group identities which people can relate to by origin, age, gender, ideology, religion, among others) helps with finding opportunities and overcoming barriers due to cultural influences.

Image 6: Cultural baby wearing is an African tradition must look across many different cultures in Africa as there are different styles of cloth and different ways of wearing.

Teaching culture-sensitive colour design is acknowledging that the human relationship with colour is highly influenced by cultural identities, and embracing the diversity and richness of

those influences as a value. It is learning from the communities and cultural groups what their attitude to colour is, how they communicate through it, and how this knowledge could be integrated to respectful design practices. For instance, some cultures will be willing to accept and buy more colourful clothing in the stores, others will be more favourably inclined towards neutrals or more classic colours; on the other hand, for certain age groups, the designer will have the possibility to take risks with the use of very saturated or fluorescent colours, while other age groups will not perceive a colourful product as appealing[4].

Discussion

The different studies and research presented in the first part of this paper, and the integration of their results, have contributed to the understanding, from its primary stakeholders, that we cannot continue teaching colour for design only from a theoretical perspective (content-centred). There is a great need to relate colour education with creative practices and the current design discipline needs. One way to make this shift in perspective concrete is by focusing on human beings (human-centred), more precisely, on the human experience of colour and the different factors that it implies. The six directions for colour education in design presented above are proposed as strategies to relate colour, a highly interdisciplinary resource, to the design discipline's new directions towards the human and the social.

These perspectives are certainly not the only way to teach colour for design through a more applied approach, but one of the possible ways forward. Other valid paths to explore in this sense are Digital Perspective or Post-Human Design and how colour can play a role in artificial intelligence, to name a few. The common element to all these possible paths is the reflection that the knowledge of colour, even coming from very remote times, can and must be adapted and updated to the human needs of today, even more when it is fundamental to a discipline in constant movement, evolution and change such as design. The knowledge about colour must stop being conceived as something static and mainly theoretical (the so-called colour theory) in favour of a more dynamic conception understood as a science of colour, a knowledge that comes from observation and testing of facts and that constantly integrates new elements to its body and fields of study.

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[4] For more information about culture-sensitive design, see van Boeijen and Zijlstra [51]. There is a considerable number of research on the topic of colour preference according to different cultural affiliations that can support the designer on this phase: on general colour preference [52] on colour preference according to gender and sexual orientation [53] on colour preference according to age [54-55]; regarding the type of product-clothing, interior, walls [56]; on cross-cultural colour preference [57].

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