

Flourishing the Biophilic Workplaces: A Co-Design Toolkit

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ABSTRACT

Indoor Environmental Quality (IEQ) is a matter of immense concern for people's health and their productivity. With this in mind, the present study relies on the Flourish wheel, first, to create a Co-design toolkit that offers an opportunity for designers and architects to indicate their perspectives on improving open-plan workplaces; due to the lack of using different design processes such as the toolkit in explaining architecture theories, this study is the first of its kind to develop a co-design toolkit in architecture, which can be used to improve the design of workplaces in a way that affects their occupants positively. Second, it is going to help in improving an office environment by means of the Biophilia design approach and bring the natural environment indoors.

In this co-design study, participants interactively discuss and share their ideas, and the researcher collates and model the results in the direction that they wished, by four steps of cards; the activity guide which is designed to explain the aim and the process of the toolkit for the user, then the flourish cards which has been created to evaluate the existing workplace environment and determine the main IEQ issues based on the flourish questions which has been divided into six categories; thermal comfort, indoor air quality, lighting environment, acoustics environment, spatial layout and the aesthetics in the workplace. After that, there are the Biophilic cards that present a list of solutions with different user budgets based on the 14 patterns of Biophilia, and finally the plants' cards; which provides the participants with a number of potted plants and some tips on how can they be used inside the office environment in order to enhance the different IEQ factors which in turn affects the occupants' wellness.

This toolkit would allow a researcher to conduct a co-study in two separate rounds virtually with 24 participants; from the design, architecture and the built environment sectors. They could identify the role of the IEQ in an office environment and show how they affect the occupants' health, well-being and productivity. Next, they could propose recommendations for improving the environmental quality of the office using Biophilic design patterns.

Keywords

Co-Design, Toolkit, Workplace Design, Indoor Environment Quality, Biophilia, Flourish Wheel.

1 INTRODUCTION

Recent trends of design and today's demographic revolution in society, most people spend most of their daytime indoors either in their homes or in their workplaces, as a result, it is necessary to design buildings where users can be helped to reduce the negative impact for the built environment. Broadly speaking, the study focuses on three main steps related to the workplace design, first the Indoor Environment Quality (IEQ) factors that mostly affect the occupants' health, well-being and productivity, then the Post Occupancy evaluation (POE) model used to evaluate them and finally the way to improve the workplace using the Biophilic design approach. In this vein, previous studies show that the connection between indoor building design and occupants' well-being is complicated (Candido et al., 2019). The evidence that the office environment has a significant impact on people in ways that may either decrease or improve their health, well-being and productivity is recognized (Abounaga, 2006; Clements-Croome, 2006, 2020; Veitch et al., 2008; Newsham, Mancini and Birt, 2009).

A strand of the literature addresses the direct effect of IEQ on human comfort (see, for example, Bordass et al., 2001; Tsushima, Tanabe and Utsumi, 2015; Mccunn, Kim and Feracor, 2018). Another strand of research concerns its direct impact on wellbeing (Mackerron and Mourato, 2013; World Green Building Council, 2014).

Traditionally, these papers have considered five physical factors that influence occupants' health, wellbeing and productivity, namely, thermal comfort (Lan, Wargocki and Lian, 2011; Agarwal et al., 2020); indoor air quality (Fisk, Black and Brunner, 2012; Mujan et al., 2019), lighting comfort (Alrubaih et al., 2013; Han et al., 2020), acoustic comfort (Wong and Mui, 2006; Di Blasio et al., 2019), and office layout (Haynes et al., 2009; Candido et al., 2019).

In fact, since human performance underlying productivity depending on ability or competence, motivation and amenities and the opportunity from support systems, the link between people's feelings and their performance can be seen clearly, together with the effects of their current environment (Clements-Croome, Turner and Pallaris, 2019). Clements-Croome has based the reasoning for his model on the work of Barrett and Barrett (2010) and Kim and De Dear (2013), which goes beyond workers' comfort and reaches out to an ideal state of well-being and productivity, as described by Maslow (1943)ab Seligmann, Diener and Biswas-Diener (2009).

The present study will use the holistic evaluation model of Derek Clements-Croome (2016) who created and developed the flourish model to help create an environment in which people thrive (Clements-Croome, 2016). The reasoning behind this evaluation model is stemmed from previous studies of health and well-being (Clements-Croome, 2006, 2018; Clements-Croome, Turner and Pallaris, 2019; Clements-Croome, 2020). The model considers the three layers of issues; the environmental factors, people's perceptions and feelings in various environments, the sparkle or 'wow' layer, this can be shown in Figure (1).

Figure 1. The Flourish Wheel



To improve the workplace, design this study adopted Biophilic architecture which is a modern architecture theory that embraces the trend to incorporate the natural world in the human-made one and explores ecological alternatives in nature, not by mimicking natural forms, but by recognizing the rules governing such types (Ramzy, 2015). The roots of this approach exist in the Biophilia hypothesis, which argues that human health and well-being ought to be affiliated with nature on a biological basis (Kellert and Wilson, 1993).

The Biophilic14 patterns inform design in the built environment based on research focused on cognitive, psychological and physiological responses to different environments developed in a report, “14 Patterns of Biophilic Design: Improving Health and Well-Being in the Built Environment” (Browning, W.D., Ryan, C.O., Clancy, 2014). While in many respects these two publications have become the most relevant since they are by far the most frequently cited, numerous other frameworks and organizations of note have been created with different approaches depending on the viewpoints and objectives.

2 THE CO-DESIGN TOOLKIT DEVELOPMENT METHOD

Co-design is a way of bringing a group of consumers, users, families or workers together to improve service. It creates an equal and reciprocal relationship between all stakeholders, enabling them to design and deliver services in partnership with each other. Planning, designing and producing services with people that have experience of the problem or service means the final solution is more likely to meet their needs (among others, Roper et al. 2018).

Marc Steen (2013) highlighted that co-design can be understood as a process of collaborative design thinking, of joint inquiry and imagination. Which jointly diverse people to explore and define issues and then develop and evaluate solutions. A process in which participants are able to share their experiences also to discuss and negotiate their roles and interests, and to jointly bring about positive change (see e.g., Happell and Scholz, 2008).

As a significant tool the “Toolkit” can be applied to many forms of content and information; it refers to a set of tools arranged together in one place. The concept of the toolkit is not new in the design field. Still, it is a consolidated practice that is used increasingly often to overcome the lack of knowledge, methodology or practical tools for a range of activities (Lockton, 2013).

Wölfel and Merritt (2013), sketching a panorama of card-based design toolkits, defined “5 design dimensions” to classify them. Toolkits can be distinguished by their intended use and the scope, duration and placement of the design process, by their system and methodology, their customisation and their formal qualities.

Physical cards have been popular design tools, perhaps because they are simple, tangible and easy to manipulate. Recent studies of card-based tools have generated guidelines for their practical development, although the structure and shape of design toolkits may vary. There are card-based toolkits such as IDEO’s Method Cards and toolkits that combine an online platform with a printable guidebook such as the “Design kit” (Designkit.org) and “The Field Guide for Human-centred Design” (IDEO, 2015).

Card-based design tools have been used as a common way of disseminating design analysis insights and making them available in the design process. Characteristically, card-based design tool research projects have found card-based tools very effective in facilitating the generation of ideas in design workshops (Vaajakallio and Mattelmäki, 2014). Cards can be an effective vehicle for transferring knowledge from theory to practice (Deng, Antle and Neustaedter, 2014). Card-based tools are argued to have benefits over other media to help in the design process (e.g. Rothstein, 2012; Möller, 2014).

So that, the first step towards constructing a viable tool was to identify a design-oriented conceptual framework for containing the peculiarities of Biophilic design applications. The framework covered some essential aspects that had to be considered in order to build a mature and complete set of guidelines on ways to design using the flourish wheel and improve workplaces with Biophilia design. The main categories for enhancing health, well-being and productivity for the occupants in the workplace were those for the IEQ factors.

Designing for the workplace means considering different levels of complexity, in which design elements relate to the occupants, to each other and a broader range of conditions. The present study

identified the need for guidance in designing Biophilic workplaces using the flourish wheel. This need created the opportunity to construct a toolkit adapted to the identified framework.

The steps followed in designing “the Biophilic Workplaces Flourish Toolkit” were as follows:

- 01) Research on the existing design toolkits and other resources associated with the relationship between the design discipline and the workplace;
- 02) Defining the vision and mission of the toolkit; outlining the requirements and positioning of the resource in the flourish wheel representation;
- 03) Designing the Toolkit elements.
- 04) Testing and validating the toolkit with experts;

In this research, it was observed that the design process needed the support of a specific design toolkit, for which she defined a broad and ambitious theoretical framework by analysing the state-of-the-art potential of existing solutions. In the end, she perceived this toolkit as a resource. To position the toolkit, the research analysed the main factors and sub-factors that should be available throughout the design process. The design of the toolkit was based on the Flourish Wheel; it describes in detail each of the subjective parameters (IEQ aspects) and objective parameters (the layout and the aesthetic values of the space) that were considered.

3 THE CO-DESIGN TOOLKIT

In aiming to support designers and architects in improving the users’ environment by Biophilia design, this analogue kit offers a framework of relevant topics and specific questions. The elements of the kit highlight the key features, putting the workplace design through 3 stages to reach the highest level of satisfaction:

1. Activity Guide: explains how to perform design activities with the support of all the components of the toolkit. Therefore, the Activity Guide is an instructional resource to assist the toolkit’s users to reach their design goals:

Figure 2. Activity guide

1 Activity Guide

I WANT TO IMPROVE AN EXCISTING DESIGN

1. STARTING POINT: THE PROJECT BRIEF :

Re-designing projects start with obtaining plans, drawings and observations about the existed situation of the workplace.

You can use the *Flourish Cards* as a base to list your key requirements. Fill it in with Post-its to reflect and define a brief (e.g. define user needs, product features ...).

As a result, you can determine both the issues and the effective design solutions using the Biophilic cards

It is important that the brief key points are shared and agreed on by clients and by the design team in order to ensure that everyone has the same vison, goals and objectives.

2. EXAMPLE THE FLOURISH CARDS AND THE BIOPHILIC ANALYSIS CARDS:

FIRST ACTIVITY: CASE STUDY ANALYSIS

Analyze a case study with the flourish cards. As you are re-designing a workplace, explore the cards and try to select similar issues that is existing in your workplace.

SECOND ACTIVITY: BIOPHILIC ANALYSIS CARDS

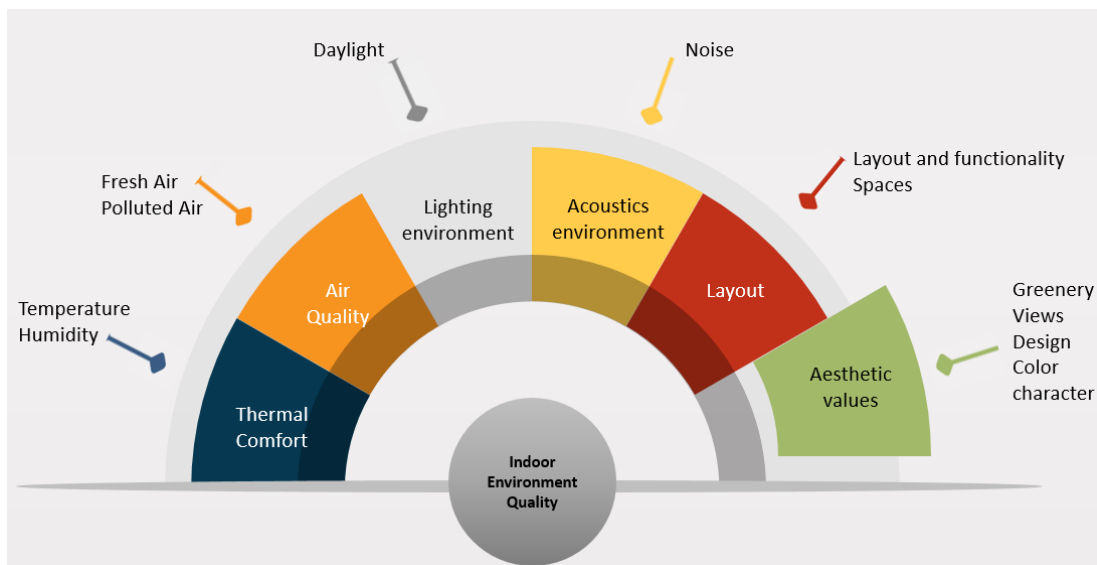
Sort the cards and select some relevant points (e.g. 5 cards). Place them on the table and brainstorm, focus on how these cards may be mixed and linked, to generate ideas.

Focus for on one area (e.g. Air quality) to select specific cards as priorities. Brainstorm on each card for a few minutes. Note down all ideas and solutions.

After defining your main issues, review the Biophilic Cards that will help you determining what is very important and what is less important based on the occupants' needs, and how this will affect their health well-being and productivity inside the office environment.

2. Flourish Cards: can be described as an expandable resource currently made up of 19 one-sided cards divided into six original categories.

Figure 3. Categories of flourish cards



The front of each card is different, to show its distinct function. Each of the categories introduces a related topic in its title and asks a critical question. It aims to allow various workplace issues to be quickly explored. It is also recognisable by a colour/pattern code and identified by one in a

sequence of numbers in the related category; this supports the structured use of the cards in combination with the other features of the toolkit.

The six categories are thermal comfort, indoor air quality, acoustic comfort, the lighting environment and the office spatial layout as shown in Figure (3). Each category represents the key factors that need to be strategically enhanced and the point of view from which to analyse an office; the division into categories lets users see the question from several different perspectives. Moreover, the pricing section was essential for encouraging the designer or the architect to choose flexibly between no budget, low, medium or high budget after deciding the main issue in each one of the categories.

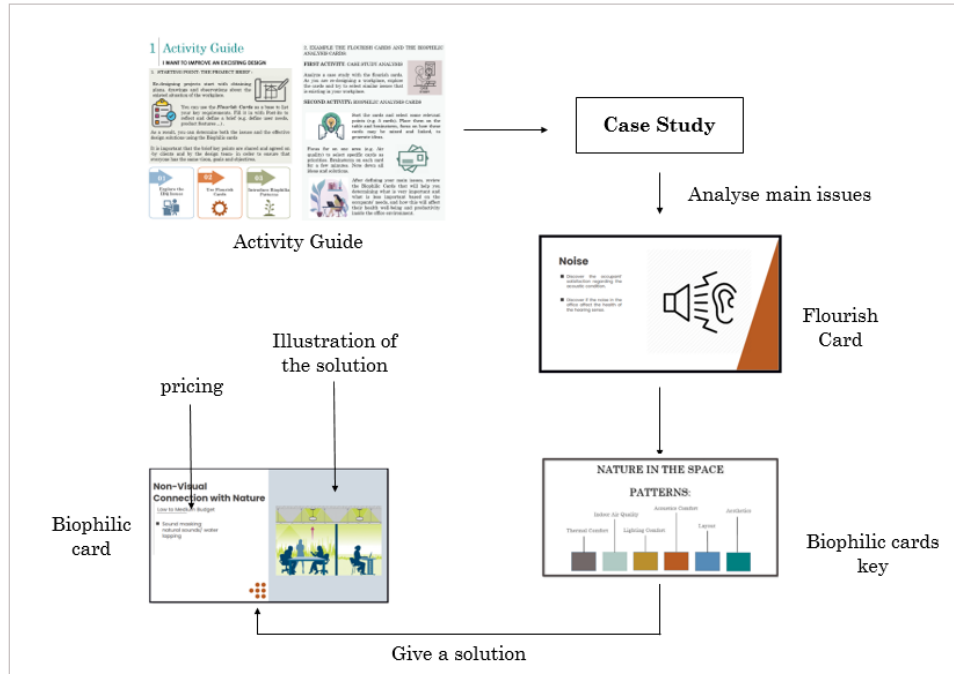
3. Biophilic Cards: Linked with the flourish cards, the Biophilic Analysis Cards are coloured, 54 in total. On the front, they show a possible solution for many IEQ issues, identified by a graphic image. An initial card also shows the colour key.

The cards propose a research exercise. Once a relevant case study is selected, the idea is to analyse it by means of the flourish cards. The Biophilic cards can answer design questions taking account of the designers'/architects' needs and expectations.

The toolkit was created to give ideas for designers and architects seeking solutions for various IEQ issues in different open-plan office environments. The present study aims to investigate how the use of Biophilia design patterns can be facilitated within various budgetary limits.

The elements are related to each other but serve different functions. To reach the best design results, they should be used together. The toolkit envisions a design methodology in which researching is the first step, followed by an immersive focus on the design itself. Therefore, the activity guide and the flourish cards are used first, followed by the Biophilic cards.

Figure 4. Relationship between the toolkit elements and the interactional flow

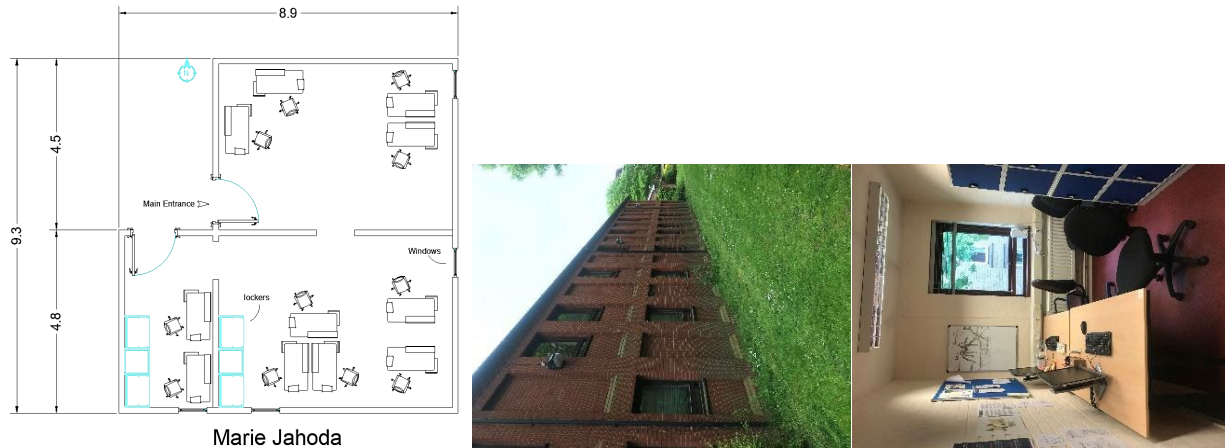


4 THE TOOLKIT EVALUATION

In testing the tool, the researcher wanted to discover if the tool properly showed information; taught users to know what they could do and how to do it; provided an efficient way to collect data; ensured that users carried out the appropriate exercises; assisted users to identify problems and get solutions, and enabled the collected data to be easy to use; or supported the researchers in their field of work and expanded their knowledge (Grinyer, 2016).

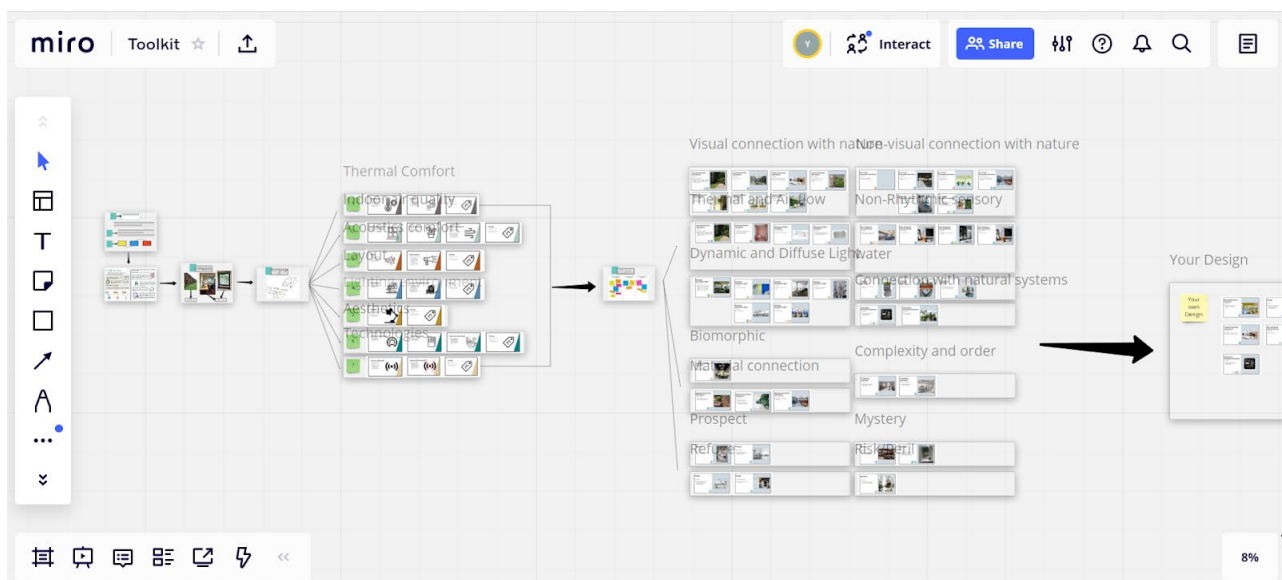
Due to the Covid-19 pandemic and the new instructions of the social distancing, it was not possible to evaluate the toolkit physically, and print the cards out as designed at the beginning, so that, Secondly, the toolkit was evaluated by six designers and architects in an online focus group using the Zoom application, with the researcher (Miro.com), to share the cards with the participants and at the same time to let them interact. The group was asked to use the toolkit to assess and improve Marie Jahoda research room as it is an old building and has different IEQ issues.

Figure 5. Marie Jahoda research room



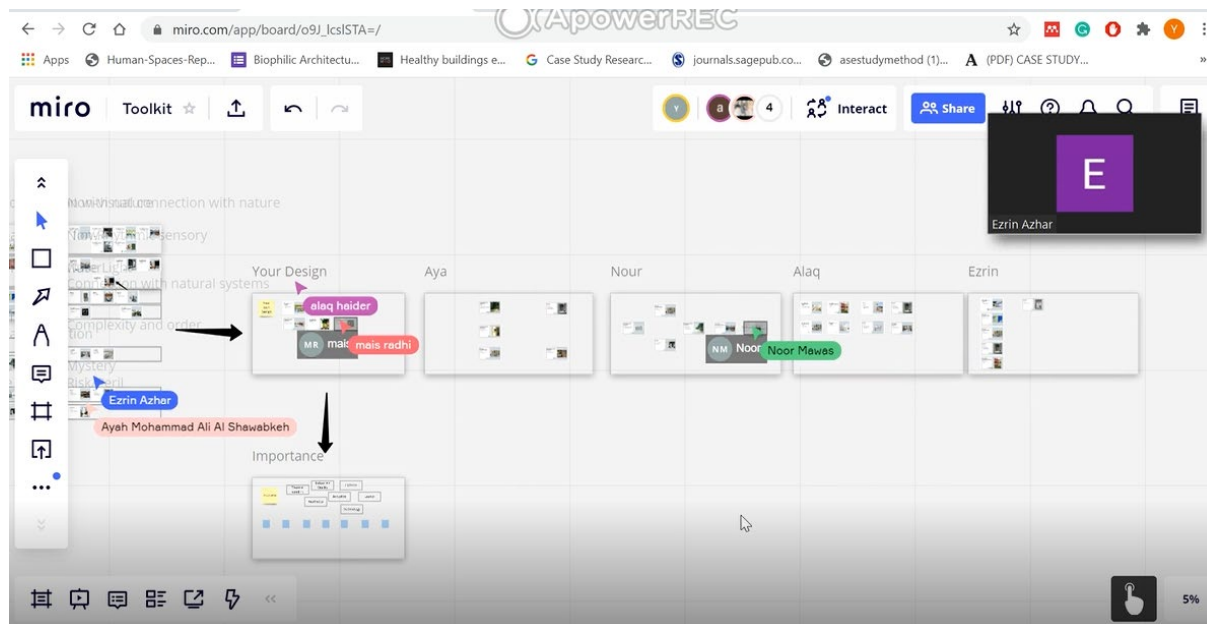
The researcher provided each one of the participants with a plan of the office, together with some pictures showing the main issues. The participants started to use the toolkit, and the components of the toolkit were available step by step on the (Miro) website that had been created, named “the Biophilic Workplaces Flourish Toolkit” as shown in Figure (6) below:

Figure 6. Miro screen



After reading the activity guide, the researcher presented the case study pictures for the current state of the Marie Jahoda research room, so that the participants could answer the questions on the flourish cards and discuss how each of the six categories affected the occupants’ health, well-being and productivity as they spent time working there. Next, the researcher asked them to use the “Biophilia Cards” to find suitable solutions for the research room problems based on the 14 patterns of Biophilia.

Figure 7. The interaction between the participants



After the exercise, the additional user comments were collected in a survey questionnaire that consisted of nine questions: (1) Is the tool easy to use? (2) Is the toolkit efficiently designed? (3) Does the tool include the information that you expect? (4) Does the tool enable you to indicate your ideas? (5) Were the objectives of the co-design achieved using this tool? which was designed for the participants.

The participants emphasise that the activity guide helped them to understand the way of how to use the toolkit cards properly step by step, they also give some comments regarding the toolkit design, such as using the key colours to link both stages together as well as the budget needed for each one of their design concepts.

Moreover, two of the designers asked to add more information about Biophilia to the toolkit in its digital version, so that the user can find out more about the benefits and how it is different from the other design approaches. The toolkit helped them to show several possible improvements for a single space, which means that it is flexible to use with different types of workplaces. As a result, most of the participants confirmed that the co-design's objectives were achieved using this toolkit.

5 RESULTS AND DISCUSSION

The online focus group took around 45 minutes, and everyone in the workshop observed all the toolkit elements. Additionally, the occupants' feedback in the questionnaire was analysed, and the advantages and disadvantages of the toolkit and its components were discussed under the headings of use, design and information delivery.

In terms of creation, most users agreed that the toolkit was very straightforward, simple, and well laid out and well explained and the colours were well coded. Moreover, the tool allowed the users to identify the quality issues in an indoor environment (here, an office), and link the problems with the occupants' health and well-being. It also defined all the categories and asked the users to put every item on a scale according to its importance; consequently, they were sure that it provided or called for detailed and well-explained information.

The tool also allowed users to arrive at design recommendations using Biophilia design patterns for a comprehensive solution. Even though one participant found that the link between the IEQ factors and Biophilia design patterns was slightly unclear, the other users indicated that the tool could clearly demonstrate this relationship.



As regards the output of the tool, the researchers felt that it served its purpose, and helped them to expand their knowledge of the relationship between workplace design and Biophilia design. It gave them a good understanding of the need to improve the workplaces since people spend most of their day in an office. Moreover, the participants suggest adding another part to the toolkit to give an idea of the types of plants that are suitable for use in a workplace, define the botanical features and show how each one could help to balance the IEQ levels and give the workplace aesthetic value.





5.1 Development of the Co-Design Toolkit




Following the result of the analysis and the users’ suggestions, the researcher added a new part to the main design of the toolkit, namely, the “Plants Cards”. These cards suggest a number of plants that can be used inside the workplace and can help to balance the IEQ levels. Generally, plants enable humans to connect with nature, providing numerous social and economic benefits, including improved performance, satisfaction as well as physical and mental health. Plants that help in offering fresh air and converting carbon dioxide to oxygen specifically at night, which in turn help in improving the IEQ in the workplace.

Besides the previous plants, some examples of the “Plants Cards” that are going to be used in the toolkit are shown in the Table (1) below; so, the designers and architects can make different scenarios in how to improve existed workplaces using the Biophilia:

Table 1: Plants Cards Used in the Toolkit

Plant Type	Details	Picture
Chamaedorea seifrizii, Bamboo Palm	one of the best indoor plants, excellent ability to filter VOC’s from the air	
Aglaonema Golden Bay	A very popular indoor plant that filter VOC’s and provide great aesthetics	

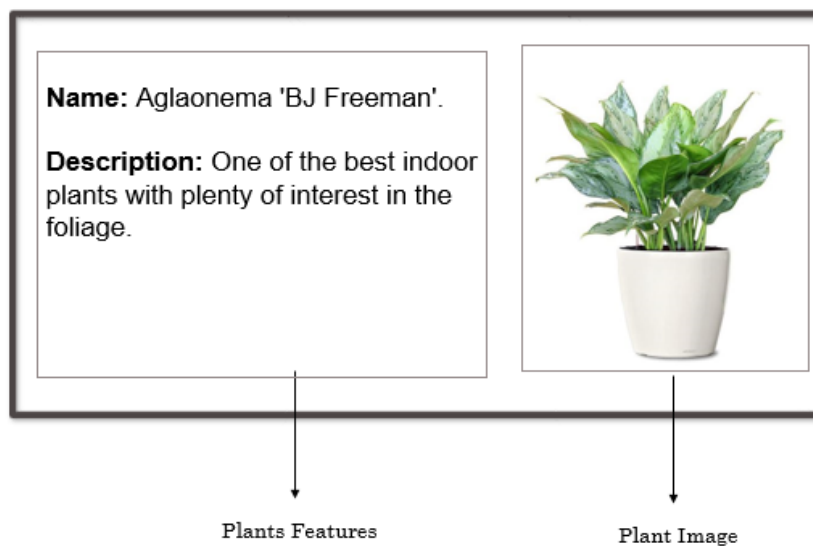
<p>Dypsis lutescens Areca Palm</p>	<p>conduct a great amount of air cleansing during the day</p>	
<p>Sansevieria trifasciata laurentii Mother in law's tongue</p>	<p>responsible for converting carbon dioxide to oxygen specifically at night</p>	
<p>Epipremnum aureum Pothos Golden/ Money Plant</p>	<p>responsible for filtering out and removing formaldehyde and other volatile organic compounds from air</p>	
<p>Dypsis lutescens Areca Palm or Golden Cane Palm</p>	<p>It needs a bright sunny location and lots of water. Best as a patio plant, as it works as one of the best plants for absorbing noises.</p>	

<p>Ficus lyrata Fiddle Leaf Fig</p>	<p>A great indoor plant if you want the plant to make a statement. A great silhouette against a bright window.</p>	
<p>Howea forsteriana Kentia Palm</p>	<p>This palm has been used indoors all over the world. It is one of the best indoor plants. It will tolerate low light.</p>	
<p>Eco Walls</p>	<p>This highlights the wall and helps support the greenery. It also helps in balancing temperature and humidity in the office.</p>	

During the improvement stage, designers and architects may recommend a mix or choose mass planting to create that special effect depending on several factors as the open-plan office has many micro-environments; some areas get full sun and some are in shade or rooms without natural light (low light plants), some are near air-conditioning and some near external doors, a balcony in the shade or full sun. Moreover, some offices will take large wide plants and some spaces tall narrow plants, some office staff have preferences about the type of plant, others simply leave it up to the designer’s expertise.

The “Plants cards” mainly give the name and a description of a plant, as shown in Figure (8).

Figure 8. Biophilia Plant Card



These cards can be used in a physical and digital version by the designers and architects to suggest the most suitable plants for use in improving the workplace.

The Physical version help improving team interaction and collaboration, it is also different for its creative customisations and easy work decomposition. However, the online version is beneficial for Asynchronous collaboration like comments, attachments and notes, remote collaboration and being inclusive to remote team members, and home and travel access for co-located teams.

6 CONCLUSIONS

This study, besides showing the process for developing a toolkit for designing workplaces using Biophilia design, also tried to reach out to the interior design community. Its goal is to open up discussion about the best ways to design a successful office environment and to engage architectural companies and stakeholders, especially in the universities, in testing and expanding the toolkit. This kit offers a methodology based on constant research which encourages being aware and up-to-date with all the latest architectural and design developments. Its structure is also able to evolve and expand. It aims to help to spread the design approach to the built environment as far as dealing with office buildings. This idea of openness is also related to the possibility of personalising the elements of the toolkit and of receiving suggestions for new forms of integration.

In this way, the kit can evolve, following future scenarios and covering updated issues and topics. The “Flourishing the Biophilic Workplaces Toolkit” has the ambition to make its users, whether designers or architects, more aware of the office design possibilities of Biophilia design.

The next step envisioned in the development of the toolkit is by testing it with another round with built environment and design experts in order to validate it physically while tangibility is valuable

for some activities, like workshop use and team discussion, a digital version or a digital toolkit element may augment some specific functionalities.

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