Designing future hybrid creative spaces using digital tools in educational institutions and organizations

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Abstract
The existing models/frameworks that serve as reference for the design of hybrid creative space in educational institutions and organizations, have shown some limitations. On one hand, current spatial design theories concerned with hybrid spaces and digital technologies are limited; on the other hand, the analysis of digital technologies’ influence on spaces conducted in Information System and Computer Science research fields rarely uses a spatial theory as a foundation. The aim of this on-going PhD research project is to develop an analytical framework that integrates creative space types and a blended space model in support of the design of future hybrid creative spaces (FHCS). The pattern language approach is applied to bring together design guidance and tools from different disciplines, in a form that can be understood and shared across disciplines. Through a pattern mining process, 323 patterns are derived from four selected disciplines. The expected outcome of this PhD project is to offer designers a useful design model (FHCS framework) and a set of design tools (design patterns) in support of the design of FHCS.

Author keywords
Design patterns; creative spaces; hybrid working; hybrid learning; blended space; spatial design.

Introduction
Conventionally, space for creative activities in educational and workplace contexts is often defined as a built formal physical environment; and these environments can also be informal spatial clusters that encourage exchanges and social networks based on in-person interactions. Users perceive and evaluate learning and working spaces through their architectural properties and physical settings (e.g., spatial layout and furnishing, lighting, colors, smells, sounds and technology, status, and image). Nevertheless, in recent years we have seen a significant shift to a more hybrid form for learning and working since the beginning of Covid-19 pandemic in 2020, and many higher educational institutions and organizations are likely to embrace “hybridity” beyond the pandemic. At the same time, “extended reality” has an emerging presence in our everyday life, and with the future of the internet and metaverse, the combination of augmented, virtual, and mixed realities will become an essential medium for social, business, learning and working engagements.

Nowadays, the term hybrid space (or blended space) is widely used as an interplay of physical and digital spaces. An urgent call is raised for designers to rethink the current design practice to accommodate future challenges when designing creative spaces in transition to hybrid forms of learning and working. Therefore, this PhD project is guided by two main research questions:

1. How future hybrid spaces for creative learning and working need to be designed to support collective creativity and innovation?
2. What technologies and digital tools can be utilized for new opportunities to aid design and enable future hybrid creative spaces?

Background
“Creative space” consists of two parts - “creative” and “space”. The term “creative” associates with activities related to design and innovation process. “Space” conventionally refers to the built environment in various scales, from urban context, architectural space, interior layout, to small single elements such as a furniture. The existing models/frameworks that serve as reference for the design of creative space in educational institutions and organizations, have shown some limitations. For example, most of the studies in the field of creative spaces are limited to the built environment and have not given enough attention to contemporary issues such as hybrid working and learning and emerging technologies (e.g. Wycoff and Snead, 1998; Dillon and Loi, 2006; Moultire et al., 2007; Ceylan, Dul and Aytac, 2008; Luz, 2008; Van Meel et al., 2010; Bustamante et al., 2018; Paoli, Sauer, and Ropo, 2019; Thoring et al., 2019; Mäkelä and Leinonen, 2021; Mov-Avi, 2022). Whereas some frameworks developed design principles for creative spaces but failed to acknowledge the importance of the connections of design components in a form of network. Therefore, it is difficult for designers and users to understand upcoming design issues and set the priorities in the design process (e.g., Luz, 2008; Van Meel et al., 2010; Thoring et al., 2019). On one hand, current spatial design theories concerned with hybrid spaces and digital technologies are limited; and on the other hand, the analysis of digital technologies’ influence on spaces conducted in Information System and Computer Science research fields rarely uses a spatial theory as a foundation (Mütterlein and Fuchs, 2019).
Theoretical framework

In a built environment, Thoring et al. (2018) identify five space types associated with creative processes in the literature and empirical evidence. They are personal space, collaborative space, making space, presentation space, and intermission space. For designers to develop hybrid space, Figure 1 presents key issues that are suggested in digital spaces as well as physical ones. Moreover, to adopt existing spatial design knowledge and theory in the context of hybrid spaces, architects and interior designers need a new model bridging the physical and digital environments, as well as new useful design tools derived from other disciplines.

An analytical framework for future hybrid creative spaces: FHCS framework

Following Lefebvre’s theory (1992) and Milgram and Kishino’s Virtuality Continuum (1994), a hybrid creative space brings together at least two distinct modes to create a new spatial typology, where a physical space flowing within a digital space and vice versa seamlessly becomes possible with technologies. Built on Blended Space model (Benyon & Mival, 2015), the author develops an analytical framework for designing future hybrid creative spaces. Figure 2 illustrates the relations between four space domains in FHCS framework. For the physical space, the author only focuses on five types of creative spaces mentioned in Figure 1. The digital space consists of more diverse forms, such as applications, data, actions and events. In the generic space where characteristics are shared by both physical and digital spaces, four attributes (ontology, topology, volatility, and agency) (Benyon, 2012) should be considered. In the hybrid/blended space, five hybrid design themes (territoriality, awareness, control, interaction and transitions) seem to be a relevant starting point for the development of a new spatial typology of FHCS. The author also intends to indicate that hybrid creative spaces can be designed with a new collection of design tools potentially derived from both physical and digital domains. Figure 3 presents a new spatial typology defined by two sets parameters, creative space types and hybrid design themes.

Research approach and method

The aim of the present research is to develop an analytical framework that integrates creative space types and blended space models (FHCS framework), in support of the design of FHCS. The review of the literature has shown that many different social-spatial design solutions exist for both physical and digital spaces, and they have been systematically organized in a form of pattern language. Identified pattern candidates are from various specific application domain, and they

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<tr>
<th>ID #</th>
<th>Design requirement</th>
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<tbody>
<tr>
<td>R1</td>
<td>Space as a platform or network for ideas</td>
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<tr>
<td>R2</td>
<td>Social interaction, micro multination</td>
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<td>R3</td>
<td>Human-centric, culture, and identity</td>
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<td>R4</td>
<td>Biophilic design</td>
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<td>R5</td>
<td>Playful experimental atmosphere</td>
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<td>R6</td>
<td>Software and hardware support</td>
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<td>R7</td>
<td>Flexible space, changeability</td>
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<td>R8</td>
<td>Ownership of space</td>
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<td>R9</td>
<td>Multi-sensory stimuli (visual, tactile, olfactory and acoustic)</td>
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<td>R10</td>
<td>Accessibility</td>
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<td>R11</td>
<td>Integrating technology &amp; infrastructure</td>
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<td>R12</td>
<td>Space and information management</td>
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<td>R13</td>
<td>Reduced stimulation, back to analogue</td>
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<td>R14</td>
<td>Bodily awareness and movement</td>
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<td>R16</td>
<td>Making spaces</td>
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<td>Creative labelling</td>
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capture and represent design knowledge of the experts. Therefore, the pattern language from Christopher Alexander et al. (1977) seems an appropriate approach to bring together design guidance and tools from different disciplines, in a form that can be understood and shared across disciplines. Moreover, it can offer a connected network of design patterns that continues to grow and evolve through the knowledge and experience input from the experts. This research is conducted in three main steps:

1. Pattern mining. A mix of methods is used to derive pattern candidates from existing pattern frameworks of various disciplines, organizations’ reports, case examples and expert interviews.
2. Pattern analysis. Collected pattern candidates are verified by a multi-case study and focus groups. Network analysis is subsequently employed to identify the network structure of patterns visually and statistically.
3. Pattern writing. This process involves proper naming and writing of patterns in a standard template with detailed description. This is realized through a workshop with pattern experts.

**Design requirements for future hybrid creative spaces**

To better understand how to create successful hybrid creative environments, the author investigates the potential challenges and opportunities of using and designing hybrid spaces, especially related to creative process. Insights are gathered from recent literature, organization reports, expert interviews, and real-world cases. Table 1 summarizes important design requirements for FHCS.

**Results and discussion**

Through the pattern mining process, various pattern frameworks and many pattern candidates have emerged from the analysis. Given their relative importance and time restrictions, the author puts an emphasis on the patterns that fit the following criteria: (1) Relevant to hybrid social-spatial de-
sign; (2) Addressing to the design requirements of FHCS; (3) Supported by empirical evidence; (4) Completeness of the pattern language, including pattern descriptions, hierarchies of the patterns, and indication of the internal links among patterns.

As a result, 323 patterns are derived from four disciplines, Spatial Design (49 patterns), HCI design (112 patterns), E-learning (36 patterns), and Game Design (126 patterns), and they are organized in their original clusters and sub-clusters (Figure 4). After further analysis of these patterns' possible application, 13 generic pattern clusters have evolved, which are mapped in relation to hybrid design themes (Figure 5).

**Conclusion and future work**

This PhD research project addresses the design issues from both physical and digital spaces in support of the design of FHCS, as well as to use a pattern language approach to bring together useful design guidance and tools from different disciplines. Moreover, this project will also offer a systemic network that continues to extend and evolve with the input of knowledge and experiences from experts. Based on current findings, the pattern candidates (or proto patterns) collected from four disciplines have proven validity in their original contexts, and together they offer a huge potential for solving problems that might not so easily be solvable alone, as interdisciplinary work with patterns is endorsed by many architects and pattern language theorists (Alexander, 2002–2005; Salingaros, 2005; Leitner, 2007; Neis, 2015). However, the proto patterns have to be transformed or updated for hybrid creative spaces, based on the FHCS framework. Future work will include the evaluation and validation of the patterns, plus analysis of their connections. The following actions are currently planned:

- Development of a spatial typology for hybrid creative environments and its implementation into the blended space framework.
- Multi-case study in three design institutions (UK and Belgium), including interviews and observations of their creative learning spaces.
- Network analysis on proto patterns to identify their new links, and evaluation of the links with focus group.
- Pattern writing workshop (focus group workshop) with experts.

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**References**


