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Editorial Aliye Ahu AKGÜN • Editor

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We are happy that our coffee breaks and face-to face studios are finally back. The exchange of knowledge and the strength of networks are re-established. So, summer has started with a big smile as we are back to our effective scientific and creative environments.

The interactivity and collectivity in such sessions are effective in terms of productivity similar to what Börekçi investigates in her paper entitled "Collective design reasoning strategies used in a creative group discussion session for effectiveness" on the effectiveness of brainstorming sessions in collective design reasoning.

So, our usual face-to-face collectivity is more productive and brings effective solutions. But, the Covid-19 pandemic oriented us to take a closer look at our curricula. Kurt Çavuş and her colleagues, in their paper "Determination of the structure of the project-based studio courses for the education of interior design bachelor" take a deep look at studios, the most intensive and the longest course in design education. Although they are focusing on interior design education, their suggestions on design studio structuring especially their methodology can contribute to other disciplines.

Not only the design studio structure, but also students' self-regulated skills have a crucial role in academic and professional achievement. Therefore, not only the studio itself but also students' motivation and skills are the subject of study for a better studio environment. Ateş Akdeniz and Turan in the article entitled "Differences in self-regulated learning strategies among industrial design students: A convergent mixed-methods study" aimed to explore differences in self-regulated learning strategies and motivational factors. They conducted their research with students from industrial design studios. They concluded that self-regulated learning skills such as the use of metacognitive, motivational and behavioural strategies should be cautiously undertaken.

One of the parameters affecting student

life is the campus itself. A self-sufficient campus where you can fulfil all your daily needs create a great experience. Özdemir and Sungur in their article "A model proposal for university campuses in the context of inclusive design" discuss one of the newest and largest campuses in Istanbul as a small city to create an evaluation model.

An educational environment, especially the university, should also expose its approach to societal challenges. In other words, a campus should also reflect its responsibility for a sustainable future. One such a new frontier is green campus. Safarkhani and Örnek in their article "The meaning of green campus in UI GreenMetric World University Rankings perspective" expose the definitions and parameters of the green campus approach.

Innovative solutions for sustainable futures are diverse. For instance, Onuk Madanoğlu and Erdem Kaya in their article "Restrictions interface proposal for the selection of sustainable stormwater management tools" present an interface for the selection of stormwater management tools by the use of local data and sitespecific evaluations.

What lies at the heart of such solutions is biophilia. Boğa and her colleagues, in their paper "Biophilic dimensions of products and their effects on user preferences" expose that biophilic characteristics of a product have started to affect the users' preferences.

Consequently, innovative solutions have the ability to change the traditions of design, that Tan and Paker Kahvecioğlu with their article "The changing customs of architectural design: The effects of building information modelling in a local context" attempt to reveal the transforming mechanism of architectural design practice under the influence of BIM as a new form of knowledge that enables the storage and management of design data.

Data storage is important in design especially to evaluate the failure and success factors behind a design. It is important to learn from the past to create the new. Çelik and Ergin, in their article entitled "How to live in a flat: A study over William Heath Robinson's representations on life in modern houses" examine modern dwelling based on previous works to offer a practical ground for future productions.

Additionally, Nisansala and her

colleagues, in their article "Performance management of contractor's quantity surveyors through the use of proper documents and records" investigate the performance of contractor QSs and show the importance of using proper documents and records on the success of the project.

For better lives, a design plays a crucial role if it includes not only the site and local characteristics but also the users' needs and cultural background. Cordan in her article, "Furniture design proposals for Syrian refugees" aims to design furniture for Syrians living in Turkey according to their needs and cultural and behavioural habits.

The interaction with different cultures changes the production of the built environment. Kahraman and Gül, in their article entitled "Modernization initiatives and architectural instrumentalization after Nasser al-Din Shah's travels to the West (1873-1896)" present such a transformation from Tehran and share the Iranian experience.

The modernization still carries traits from the past. Ural and Sarıman Özen, in their article entitled "An analysis of heterotopic space: Hasanpaşa Gazhane, enlightening once again" studied Hasanpaşa Gazhanesi, located in Kadıköy to make 'heterotopic' evaluation of the chosen space and to examine the concept with concrete example of some refunctionalized buildings to make the user feel the old and new function at the same time, and in Foucault's words, the user gets exposed to other space experiences.

Space experience can be diverse in the urban context as well as in space creation. One of the greatest examples is in street art. Street art can affect both positively or negatively the urban space. Kolçak and Kaya Erol, in their article, "Creating spaces for art: Long term impacts of street art in the urban context" examine the relationship of street art and public space.

Public space that is especially used by crowds should follow regulations, and design of such places should include safety issues first. Kurumak and Uysal, in their article "Calculating the safe capacity of a stadium: Applying methods for assessment capacity on example of Konya City Stadium" examines Konya City Stadium by the criteria and the methods which are stated in national and international regulations were gathered in a sequence.

Enjoy our July 2022 issue...

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Collective design reasoning strategies used in a creative group discussion session for effectiveness

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Abstract

The Controlled Input Method is a brainstorming technique that adopts both a nominal and an interactive approach, which has been indicated in the literature as making creative group discussion sessions effective. A brainstorming session using the Controlled Input Method was carried out as the initial stage of the design process of a graduate-level design project in an educational setting. The brainstorming session was found effective in terms of productivity. The documentation of the session was qualitatively and quantitatively analysed for identifying the factors contributing to the session's effectiveness. The analyses revealed seven discussion topics on the problem area, three solution areas gathering design ideas, seven statement types used in the documentation, and two problem frames situating the discussions, contributing to the identification of fifteen strategies used in collective design reasoning. The strategies are discussed in terms of content creation, problem exploration and idea generation as functions of design reasoning, and in reference to divergence, convergence, quantity, situatedness, and goal-orientedness, as indicators of effectiveness.

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Controlled Input Method, Creative group discussions, Design reasoning, Effectiveness of brainstorming.

1. Introduction

Creative group discussions are generative discussion sessions carried out in groups, for the goal-oriented exploration of particular topics. In the field of design, creative group discussions may be carried out in various stages of the design process and for different purposes, such as problem exploration, idea generation, design detailing or evaluation (Pahl & Beitz, 1996; Wright, 1998). Studies on creative group discussions in the design context have emphasized the methods used and outcomes produced (e.g. Bonnardel & Didier, 2020; Kazakci et al., 2015; Murphy et al., 2022). There is also an increasing interest in discussions generated during the design process. Many studies analyse conversation content in order to understand how communication and negotiation contribute to design, with a focus on the social aspects of collaboration in design (e.g. Matthews & Heinemann, 2012; Oak, 2011), designerly thinking skills reflected in the conversations (e.g. Lloyd & Oak, 2018; McDonnell, 2018) and the forming of shared mental models (e.g. Nik Ahmad Ariff et al., 2012). This paper is an attempt at exploring the topic in terms of the design reasoning involved in achieving effectiveness for a creative group discussion session in the generation of situated content and usable design ideas.

Design reasoning is purposefully using reasoning and imagining simultaneously, deciding on the timing and amount for each depending on the nature and requirements of the situation, in mental operations such as problem solving, concept formation, making logical inferences, planning, deliberating, interpreting, carrying out argumentations, decision-making, creating, form giving and evaluating (Cramer-Peterson & Ahmed-Kristensen, 2016; Roozenburg & Eekels, 1995). The mental operations that constitute design reasoning are carried out towards design cognition that is the integration of designerly thinking processes and design representations achieved through the synthesis of knowledge, information and experiences (Goldschmidt & Weil, 1998), and manifested through the

designerly practices of framing, which are moving, reflecting and reframing (McDonnell, 2018).

Design reasoning can become observable to a degree, when the design cognition process takes place in an interactive creative group discussion setting and is externalised through communication various channels among the participants, such as verbal communication. The paper describes a study on the identification of the design reasoning strategies for effectiveness in self-reported creative group discussions carried out in a brainstorming session using the Controlled Input Method. This session was the initial stage of a six-week graduate-level design project on shelf-ready packaging (SRP) solutions for baby food jars. The brainstorming session was carried out immediately after the project brief was distributed, with the goal of exploring the problem area and obtaining a set of design ideas that could be pursued for the project. Various group and individual idea generation methods for expanding the solution space, followed by design development and evaluation methods for selecting the final design solutions were used for the remaining stages, and the expected outcome was a full-scale model of the final SRP design solution individually submitted by all participants. At the end of the project, while making a review of the design process and its outcomes, the author was able to determine that the brainstorming session had reached this goal: 12 out of 13 final design submissions made for the project used ideas generated in this brainstorming session.

Based on this recognition, this paper is mainly concerned with the outcomes of the brainstorming session using the Controlled Input Method, and argues that the session was productive in terms of the content of the creative group discussions carried out, and therefore effective in problem exploration and idea generation. The paper maintains that the effectiveness of the session owes to the collective design reasoning that took place during the discussions and enquires into the underlying mechanisms, referred to in this paper, as the design reasoning strategies. Accordingly, the study described in this paper explores the effectiveness of this session with the aims of 1) establishing the design reasoning strategies that the participants used during the discussions, and 2) describing the collective design reasoning process that helped achieve this effectiveness.

In pursuing its aims, the paper reviews the literature on effectiveness in creative group discussions and brainstorming as a method in conducting group discussions, setting the theoretical framework for the study. The paper then describes the study, covering the data collection and analysis procedures. The data of the study is verbal (written) and visual (sketched) discussion content, individually documented by the participants during the session. The methodology used for data analysis adopts both qualitative and quantitative approaches in identifying the topics covered, solution areas developed, statement types used and problem frames formulated in the discussion documentation. The findings provided insights into the collective design reasoning strategies involved in the discussions, and their contribution to the effectiveness of the session. The strategies are expected to widen the understanding of the collective design reasoning process in creative group discussions and contribute to the planning and moderation of such sessions in design education and practice, for effectiveness.

2. Literature review

In order to establish a theoretical framework for the study, literature review has been carried out on creative group discussions, how effectiveness has been defined for creative group discussions, factors that contribute to effectiveness in creative group discussions, problems that may arise during creative group discussions hampering effectiveness, and methods used for overcoming these problems.

2.1. Effectiveness of creative group discussions

The expectation from creative group discussions is the generation of a substantial number of ideas, which seems to be considered as a manifestation of effectiveness. On the other hand, Sutton and Hargadon (1996) state that the productivity of a creative group discussion cannot be considered as limited to the efficiency at idea generation alone. They acknowledge the contribution of face-to-face discussions to the morale and motivation of groups. In a study conducted at a leading product design company, they identify various contextual factors that contribute, such as motivation, skills and expertise of participants, past and future task interdependence, and, whether and how the ideas are made use of. The efficiency of collaborative creativity is highly related to group establishment, meaning, for group members to have had continuous interaction in the past therefore being used to producing together, and the operationalization of the brainstorming session allowing group creativity to perform realism within context (Levine et al., 2015).

Effectiveness in design collaboration is possible when collaborators can all apply their skills and knowledge on the design task, and abilities for working collaboratively towards a common goal (McDonnell, 2012). Progress in creative group discussions is the result of the systematic pursuit of certain propositions, timely evaluation of design moves, early confrontation of problematic issues, and evaluation of the consequences of a line of reasoning (McDonnell, 2018). In effective discussions members show skills in allowing others to answer questions they have raised, or picking up on a line of thought brought forth by another, and building on it (Goldschmidt, 1995). Situated evaluations taking place during discussions actually help in forming and elaborating on the problem frameworks, through which members are able to stimulate one another's divergent thinking and integrate individual ideas into the creative output (Harvey & Kou, 2013). Participants in creative group discussions are seen to employ interactional strategies that support effective design collaboration such as negotiating during design moves; acknowledging that the contributions are tentative; accommodating disagreements by postponing resolution and keeping on designing; and including emerging design possibilities within the progressing design (McDonnell, 2012).

Collective design reasoning strategies used in a creative group discussion session for effectiveness

Successful group discussions display coherent development in the pattern of conversation (Dong, 2005). Coherence means that two discourse entities in a discussion are topically related, and the connections between the elements of the perceived whole are identifiable (Menning et al., 2018). Achieving coherence in team settings requires collaborative effort, through constant assessment of, and agreement upon the discourse carried out. If the discourse entities are closely connected, coherence is high; if they are distantly connected, coherence is low. Low coherent statements act as disruptive stimuli and lead to mental focus shifts by directing team members' attention to new topics (Menning et al., 2018). This in turn allows divergence during idea generation, as innovative meaning emerges between concepts, and focus shifts are extended to multiple planes allowing interpretative freedom and associative behaviour (Menning et al., 2018).

2.2. Divergence and convergence in creative group discussions

It is believed that idea generation mainly involves divergent thinking. On the other hand, evaluation-centred discussions based on convergent thinking may also take place in a productive manner; Harvey and Kou (2013) explain evaluation-centred discussions to be an important aspect of collective creativity, during which individual ideas can be filtered and integrated into a group perspective, and novel ideas can be identified and built on. Goldschmidt (2016) associates divergent thinking with unfocused ideation for the consideration of various aspects for a topic, and convergent thinking with focused ideation that evaluates a particular aspect for a topic. Both types happen in cycles of design moves, which are segments that reflect a unit of categorizable thought (Goldschmidt, 2016). Each design move involves forelinks, representing divergent thinking, and backlinks, to a lesser percentage, representing convergent thinking. As new ideas are being generated, earlier ideas are also considered and thus, new ideas are elaborated on with reference to past development.

Experienced designers typically search for solutions early within the design process, while still developing an understanding of the problem, explained as problem-solution co-evolution (Darke, 1984; Dorst & Cross, 2001; Lawson, 2000; Lawson & Dorst, 2009; Wiltschnig et al., 2013). This is seen in the group context as well. Stempfle and Badke-Schaub (2002) explain the thinking sequence of design teams as generating an idea, immediately followed by the evaluation of the idea and its acceptance if it is found satisficing, with the purpose of reducing complexity, and saving time and cognitive effort when facing incomplete information.

Larey and Paulus (1999) explain that when groups arrive at a consensus during creative group discussions, they tend to restrict their focus of attention. Harvey and Kou (2013) explain this as the tendency of members to converge around those ideas found worth of pursuing, so that they can build on them. In group discussions, many ideas are produced (divergence), but for a limited number of topics (convergence) discussed for an extended time (Bouchard et al., 1974; cited in Larey & Paulus, 1999). This simultaneous use of divergent and convergent thinking is an ability that designers develop in time (Tovey, 2012), and requires that designers continuously frame and reframe how they see the world (Carroll et al., 2012).

2.3. Problem framing in creative group discussions

Problem framing is the determination of a frame through which designers initially view the problem space and identify the core features to address (Cross, 2011; Dorst, 2011; Paton & Dorst, 2011; Schön, 1983). Once solving the problem as seen through the frame, designers move on to new frames they set for themselves. This process contributes to their mental representation of the design problem (Björklund, 2013), and the determination of priorities early on in the process (Cross, 2011). Naming of these priorities supports design moves and serves to bind together the fragments in a group discussion (McDonnell, 2018). Frame establishment takes place in the early design episode, where "what to design"

is decided upon (Stumpf & McDonnell, 2002). The process takes place as: problem framing, naming issues to attend within the frame, generating moves towards a solution, and reflecting on the outcomes of these moves. During argumentation individual frames are shared within the team for carrying out moves and integrating reflection in the process (Stumpf & Mc Donnell, 2002). The team may at times generate conflicting frames. Then, during argumentation persuasion and linguistic skills are used for sharing opinions, beliefs and values in creating the context. To overcome frame incompatibility, dissociations take over, creative changes in the input are used, and established concepts are separated into new ones. In settings where individual frames do not conflict, they converge towards a team frame (Stumpf & McDonnell, 2002). Successful frame establishment can affect the design process and the quality of its outcomes positively (McDonnell, 2018). Therefore, during design collaboration the team needs to be aware of the dominant frames that emerge, and reinforce them for their sustainment (Stumpf & McDonnell, 2002).

2.4. Difficulties of conducting creative group discussions

There are difficulties in conducting creative group discussions, such as finding the right procedure to follow, managing the group, documenting the session, and making use of the outcomes. There are the risks of losing ideas if not well documented, or not exploring them to their full potential. The group dynamics may hinder the effective participation of all, as production blocking may happen in the presence of other speakers (Paulus & Dzindolet, 1993), or the ideas of speakers may restrain the chain of thoughts of others lacking the required knowledge background (Paulus & Brown, 2007). Groups may divide into smaller ones carrying out separate discussions (Osborn, 1963). Sidestepping may occur (Kowaltowski et al., 2010), and discussion topics may diverge from the main problem area (Paulus et al., 1993). Participants may be reluctant in sharing ideas for competitive reasons, or due to evaluation apprehension, which is the anxiety of being criticised (Osborn, 1963). There may be those who free-ride, relying on the effort of others in the group (Larey & Paulus, 1999; Osborn, 1963), or those who believe their contribution will be overlooked, explained as dispensability of contribution (Diehl & Stroebe, 1987). Conflicts and disagreements may arise within a group requiring resolution (Cross & Clayburn Cross, 1995; Kurtzberg & Amabile, 2001). Besides, the group's performance level may remain at that of the member with least productivity (Larey & Paulus, 1999).

2.5. Brainstorming as a creative group discussion method

In terms of the difficulties mentioned above, brainstorming is an effective method for creative group discussions, as it encourages the participation of all, and organises discussions towards a common goal. The method was introduced by the advertising executive Osborn (1963) to facilitate creative thinking in groups, and is used for problem exploration, idea generation and decision making within a short time. The method expects the contribution of a group of people from diverse backgrounds, and leads to a flow of ideas generated through associations triggered by discussions (Osborn, 1963). The four rules characterising this method are ruling out criticism while ideas are being suggested; allowing free-wheeling of discussions so that inspiring ideas can be offered; aiming for quantity of ideas, as quality ideas are expected to turn up among many generated; and striving for the combination and improvement of ideas offered in the session (Osborn, 1963).

The effectiveness of brainstorming has often been subject to study particularly in the fields of psychology, collective creativity and organisational behaviour. Many studies have reported on the effects of subject personalities (Furnham & Yazdanpanahi, 1995), procedure instructions (Paulus et al., 2011; Rietzschel et al., 2014), task description, performance self-assessment of subjects (Diehl & Stroebe, 1987), idea exchange (Paulus & Yang, 2000), group goal-setting and feedback (Eisele, 2012), group effectiveness, idea selection (Faure, 2004), idea evaluation

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(Putman & Paulus, 2009), and duration of sessions (Henningsen & Miller Henningsen, 2013). Such experimental studies are generally conducted in laboratory settings, testing social factors affecting the discussions, among individuals, and members of nominal and interactive groups of small size (e.g. three or four members).

A main issue of debate has been whether nominal (members work individually within a group) or interactive (discussions take place between members) brainstorming works best in terms of quantity and quality of ideas. Experimental studies show that nominal brainstorming produces more ideas in number compared to interactive brainstorming, whereas others indicate that the quality of the ideas generated in interactive discussions are better (i.e. good, original, unique, creative, feasible) (Diehl & Stroebe, 1991; 1987; Harvey & Kou, 2013; Larey & Paulus, 1999; Levine et al., 2015; McMahon et al., 2016; Paulus et al., 1993; Rietzschel et al., 2014; Rietzschel et al., 2006; Sutton & Hargadon, 1996). An adopted approach for effective group discussions is following techniques that allow both interactive and nominal brainstorming (Faure, 2004; Osborn, 1963; Paulus, 2000; Wodehouse & Maclachan, 2014). An incubation time carried out individually, during interactive group discussions, allows the participants to retrieve discussed ideas from memory, combine them with ideas they generate, and feed them with their individual repertory of knowledge (Paulus & Brown, 2007).

2.6. Brainstorming techniques

Throughout years, variants of the brainstorming method have been developed to ensure its effectiveness depending on the nature of the problem that is handled. Examples include the 6-3-5 Method, Gallery Method (Pahl & Beitz, 1996), Brainwriting Pool (Roozenburg & Eekels, 1995), Braindrawing (Gause & Weinberg, 1989), Crawford Slip Method, Delphi Method (Kowaltowski et al., 2010), computer-mediated electronic brainstorming (Denis & Valacich, 1993) and Controlled Input Method (Wright, 1998), aiming to overcome the negative effects of social factors, and production blocking in particular.

Following structured brainstorming procedures is known to result in more creative solutions compared to unstructured brainstorming procedures (Gray et al., 2019). Wright (1998) specifies that a casual approach to brainstorming may result in the loss of potential benefits, and recommends the Controlled Input Method, which ensures that each member contributes to, and also documents the discussions. The method follows a procedure in which discussions are carried out in 11-minute rounds (Wright, 1998): the first member who speaks, has three minutes to make design suggestions, and produce sketches if necessary, during which no other member can speak. In the following five minutes, the group members are allowed to speak without criticism and ask questions to develop the proposed ideas. A further three minutes are then given for members to process the discussions individually, taking notes and making sketches. This procedure is repeated for all members, after which the ideas are compiled from the notes.

The Controlled Input Method has been used occasionally for projects carried out in this graduate course for allowing both nominal and interactive brainstorming. Over time a variant of the method has been developed with the educational objectives of managing time, and encouraging verbal and visual documentation. It is this variant that was used in the study presented in this paper (see Section 3.2.3).

2.7 Theoretical framework for effectiveness of brainstorming sessions

As seen from the literature, many studies have been conducted on effectiveness in creative group discussions, associating with productivity in particular. Although many factors for effectiveness been identified, few of these studies explain the design reasoning involved. Based on the literature review, this paper accepts the effectiveness of brainstorming sessions as productivity owing to successful group establishment and frame establishment. Group establishment is a result of the functions of: productive interaction in the past (Levine et al., 2015) with the same group, task interdependence (Sutton & Hargadon, 1996) for knowing how the output is going to affect the following steps of the process, and operationalization (Levine et al., 2015) for performing realism within context in the discussions.

A supportive group establishment occurs when the group members: have motivation and willingness to participate; are able to apply their skills and knowledge; show collaborative working abilities; share an understanding of the goal (McDonnell, 2012); are able to pick up on others' lines of thought to build on earlier discussions (Goldschmidt, 1995); accommodate disagreements for the progression of ideas (McDonnell, 2012); refrain from premature criticisms (Osborn, 1963); and carry out constant assessment in the form of situation evaluation (Harvey & Kou, 2013) and negotiation for design moves (McDonnell, 2012) for agreement on issues to address and coherence in the discussions.

Frame establishment in an interactive group discussion context is a result of the functions of: simultaneous use of divergent thinking and convergent thinking for coherence (Goldschmidt, 2016; Menning et al., 2018; Tovey, 2012); problem-solution co-evolution to reduce complexity, restrict focus of attention and save time and cognitive effort against incomplete information (Dorst & Cross, 2001; Lawson, 2000; Lawson & Dorst, 2009; Stempfle & Badke-Schaub, 2002; Wiltschnig et al., 2013;); problem framing for a collective mental representation of the design problem (Cross, 2011; Dorst, 2011; Paton & Dorst, 2011; Schön, 1983); collective naming of what to design (Stumpf & McDonnell, 2002); and collective decision making on the issues to be addressed (McDonnell, 2018). Consensus in these is desirable (Dong, 2005; Larey & Paulus, 1999), though agreement on all issues is not particularly required. Rather, the objective is coherence in the content, which may slightly diverge and even conflict towards alternative solution areas (Menning et al., 2018).

Successful group establishment and frame establishment facilitate high performance in problem exploration and idea generation in interactive and nominal group discussions. These performances manifest in creative group discussions with reference to the diversity of topics covered (divergence), extent to which topics are explored (convergence), number of ideas generated (quantity), their relevance to the design problem (situatedness), and their usability in the following stages of the process (goal-orientedness).

This paper argues that these manifestations are a result of the design reasoning strategies used in the generation of creative group discussion content and the findings are examined accordingly. This theoretical framework makes it possible to bring a design reasoning perspective to effectiveness in creative group discussions, which is identified as a gap in the literature. The study that follows, investigates design reasoning in creative group discussions through this framework.

3. Methodology

Based on the above-described theoretical framework, a study was planned with the aim of investigating the effectiveness of brainstorming in terms of frame establishment, resulting from collective design reasoning for productivity. The study involved the conduct of a nominal and interactive brainstorming session, and an in-depth analysis of the discussion documentation that consisted of written notes and sketches produced by the 13 participants during the session on a total of 156 A4-size sheets. The research question was:

 How did collective design reasoning take place in the creative group discussions towards productivity?

3.1. Participants and setting

The session was carried out in an educational setting familiar to the participants (the usual classroom for the course). The brainstorming session was attended by 13 graduate students all holding a bachelor's degree in industrial design. There were eight female students and five male students. Ten were from Turkey, and three were from the Netherlands. Discussions were carried out in English. All having a background in industrial design education, the 13 participants were accustomed to carrying out creative group discussions, which provided them the necessary method mindset (Daalhuizen et al., 2014). The participants had collective creativity experience in an earlier short project carried out for the same course and represented an established group (Levine et al., 2015). The session was the initiating phase of a design process that the participants knew would continue for a period of time and participants were aware of the task interdependence (Sutton & Hargadon, 1996). Besides, the systematic brainstorming procedure called for constructive thinking styles that involved generating discussions and documenting them simultaneously in writing (constituting the data set for the study). These factors contributed to explaining the high performances of participants in terms of group establishment.

3.2. Design problem

The brainstorming session was carried out for corrugated cardboard (CC) shelf ready packaging (SRP) solutions for baby food jars. Shelfready packaging is a type of retail packaging for fast-moving consumer goods that has an extensive usage, covering transportation from manufacturer to retailer, where it is directly used for displaying product content on market shelves (Dujak et al., 2014; Romanik, 2013). A typical SRP solution for baby food jars is shrink wrapped cardboard trays holding from six to twenty jars. The project brief called for design solutions that would make it easier for market staff to arrange shelves with jars, and for consumers to visually and physically access them.

3.3. Brainstorming procedure

The session was moderated by the author. This involved the distribution of the project brief, a short discussion on the topic using images and examples of SRPs and baby food jars, distribution of the brainstorming procedure brief, explanation of the rules of brainstorming, and suggestions on what the participants can talk about (e.g. storing and displaying the product, users, environment, materials, immediate ideas for design solutions, review of similar products). The remaining moderation was limited to starting the session, keeping time, and supervision in adhering to the brainstorming rules.

The procedure followed for the session was a variant of the Controlled Input Method. In this variant procedure, each round was given 5 minutes. The first speaking participant had three minutes to think aloud, make design suggestions, and produce sketches on the whiteboard if necessary, during which s/he carried out nominal brainstorming on the problem area, while the other participants were not allowed to interrupt and silently took notes on distributed sheets. In the following two minutes, interactive brainstorming took place; the other participants were allowed to speak without criticism and ask questions to develop the proposed ideas, while processing the discussions as notes and sketches. This procedure was repeated for all members. As there were 13 participants, the session was held in 13 rounds.

Participants sat randomly in a circle around a large desk; the first participant volunteered to speak for the first round, and the following rounds continued with the person on the right, until all participants took turns. As the moderator started time keeping, the first participant started thinking aloud, with no initial probe question. At the end of three minutes, the moderator announced that the think aloud period had ended, and that the two minutes of interactive group discussion period had begun; then announced that these two minutes had ended, and the following round of three minutes for the next participant to think aloud had begun, and so on. Time was kept using a chronometer, and the duration was a total of 65 minutes (13 participants x 5 minutes).

3.4. Data collection and nature of the data

A4 size sheets were distributed for participants to take notes and make simple sketches during the rounds of discussions. On each sheet was a chart containing three table columns titled "Summary", "Comments and Criticisms", and "Notes and Suggestions". Each participant would fill in a separate

Sheet No: 10 Date and Time: 29 No Speaking Memb Documenting Member: PA Comments and Criticism Notes and Suggestions 2 turkish coffe aps packing (previous project) the It would not matter somuch if you throw armay notera 0.150 but packoging ackage the ord boord gones ? (Renk) any gou sheet is important to prevent west toys i mine condisonal is not a very anot ust schorts national charle for duildren to play :) the stick condi 20 ted cst

Figure 1. A documentation sheet filled in the session (Round 10, Participant A).

sheet for each round of discussions. As the participants would not be taking notes in their own rounds, each was distributed 12 sheets. At the end of the session, 156 sheets were collected (13 participants x 12 sheets) that included written statements and some sketches (Figure 1).

The session documentation produced qualitative data comprised of verbal and visual notes taken on separate sheets for each round, by the participants listening to: 1) their peer thinking aloud during nominal brainstorming, and 2) the group discussions during interactive brainstorming. The nature of this data is not an exact recording of what was being said, but an account of the discussions individually processed by the participants. These documentation sheets included common accounts of think aloud statements followed by statements made during interactive discussions, and individual accounts of each documenting participant's interpretations and contributions (processed statements produced after individual verbal and non-verbal thought).

3.5. Data analysis procedure

The data set was subjected to two consecutive analysis procedures carried out by the author alone. The analyses were planned to be both qualitative and quantitative, looking at the formal qualities as well as content of the data. The goal of the analyses was to determine the origination, development and finalization of the discussion segments, through which it would be possible to trace the collective design reasoning process.

3.5.1. First data analysis

The first analysis included qualitative thematic and content analyses (Krippendorf, 2004; Savin-Baden & Howell Major, 2013). The aim of this initial analysis was to obtain insights into the group's performance in content creation for problem exploration and idea generation. This required the identification of the discussion topics to assess the diversity of issues addressed and the extent to which these issues were explored, and of the solution areas to assess the diversity and quantity of solutions.

All written statements (404) were transferred into digital format using the Microsoft Excel program. The sketches (81) were identified as depicting an idea (e.g. design solution, detail, mechanism), context (e.g. environment, user), or situation (e.g. opening, removing, stacking), and added to the list of statements as written descriptions. The resulting 485 statements were listed according to the respective rounds, and also according to participants.

The lists were cross-examined using open coding to identify the discussion topics. The topic units identified from all the statements were categorised according to problems put forth, issues and further actions suggested. The statements for topic categories were then counted for frequency of mention to display the importance that participants gave to them. The statements were then distributed according to rounds for mapping topic, category and subcategory interdependence. The statements providing design solutions were further investigated for their design idea units, and these were thematically grouped into solution areas. This process required repeated reviews of the lists and reorganisation of the codes, towards a saturated thematic categorisation of the discussion content. The process ended with the determination of discussion topics and solution areas.

3.5.2. Second data analysis

In order to reveal the design reasoning involved in the discussions, a second formal content analysis was planned for identifying the types of statements used in the documentation, and relating these types to the discussion content. The aim was to identify the purpose of use of these statements and how they contributed to the progression of the discussions.

The 485 statements were re-examined for the formal qualities and sentence types, according to rounds. Among the statements were those of only one word, such as an exclamation adjective like "*Interesting* (Participant I, Round 2)" or a declaration noun like "Decoration (PE, R13)". There were declarative non-finite clause statements, such as "Not to drop the packs (PF, R5)". The majority of statements were complete sentences, some long, such as the imperative sentence "A pack should include ingredient and amount that matches physical nutrition needs of baby (PH, R6)" and others short, such as the declarative sentence "Handles can be nice (PK, R3)". There also were interrogative sentences, like "How many jars are carried in the bag? (PM, R8)".

Types of statements were first identified on the list of rounds. This initial breakdown was cross-checked on the

list of participants. This initial examination revealed four types of statements, independent of sentence types and in terms of purpose, as remarks, objectives, problems and solutions. Following, statement types were categorised in a new list, with the rounds in which they were produced and the participants that produced them indicated in columns. On this list, statements were classified into discussion topics to reveal the differences of expression once the contents were the same. This helped refine the statement categories and identify subcategories based on how they were expressed, and what they indicated. The finalised lists were transferred back to lists of statements according to rounds, ending with the identification of the types of statements used for the discussions by all participants in each round. The final lists made it possible to identify the development trajectory of the problem frames, also displaying the origination, development and finalization of segments for each discussion topic.

Overall, the analyses were iterative rather than linear, and the results of the first and second analysis procedures were cross-checked in structuring and refining the findings. Data analysis was

Table 1. Topics of discussion and their sub-categories.

CONTENT	CONTEXT		
A. Packaging (262)	E. Supermarket (208)		
A1. Packaging concept (65)	E.1. Supermarket context (6)		
→ A.1.1. Packaging type (45)	E.2. Display (142)		
→ A.1.2. Multipacks (20)	\rightarrow E.2.1. Stackability (46)		
A.2. Description (125)	→ E.2.1.1. Stackability (13)		
→ A.2.1. Components (73)	\rightarrow E.2.1.2. Shelving (6)		
→ A.2.1.1. Cover (23)	→ E.2.1.3. Stackability of packs (23)		
→ A.2.1.2 Flap (10)	→ E.2.1.4. Stackability of jars (4)		
→ A.2.1.3 Handle (21)	\rightarrow E.2.2. Visibility (96)		
\rightarrow A.2.1.4. Shrink wrap (11)	→ E.2.2.1. Visibility (36)		
→ A.2.1.5. Other (8)	→ E.2.2.2. Visibility of brand (22)		
→ A.2.2. Physical features (52)	→ E.2.2.3. Visibility of content (38)		
\rightarrow A.2.2.1. How be? (8)	E.3. Marketing (47)		
\rightarrow A.2.2.2. Inclined (9)	\rightarrow E.3.1. Promotion (8)		
→ A.2.2.3. Box-like (9)	→ E.3.2. Gifts (39)		
→ A.2.2.4. One jar removable (9)	E.4. Logistics (13)		
→ A.2.2.5. Diverse shapes (17)	F. Home (24)		
A.3. Protection (31)	F.1. Home context (9)		
A.4. Modification (41)	F.2. Storing (15)		
→ A.4.1. Immediate Use (35)	G. People (55)		
→ A.4.2. After use (6)	G.1. Market staff (5)		
B. Packaging Content (105)	G.2. Consumer (13)		
B.1. Jar (54)	G.3. User (37)		
B.2. Jar cap (9)	\rightarrow G.3.1. User identification (30)		
B.3. Food content (42)	→ G.3.2. Safety (3)		
C. Material (88)	\rightarrow G.3.3. Feeding (4)		
C.1. Material types (43)			
→ C.1.1. Types (4)			
→ C.1.2. Corrugated cardboard (22)			
→ C.1.3. Glass (10)			
→ C.1.4. Other (11)			
C.2. Production (7)			
C.3. Effective usage (34)			
D. Waste Management (52)			

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D.2. Recycle (17)

D.3. Deposit (8)

concluded when the categorizations for topics, solution areas, statement types and problem frames provided a coherent and saturated structure.

4. Findings

At the end of the analyses, seven main discussion topics, three solution areas, seven statement types, and two problem frames were identified.

4.1. Discussion topics

Two main themes were determined for the discussion content, dividing into seven topics, 22 categories and 45 subcategories (Table 1). The main theme of concept gathered the topics of *packaging* (A), *packaging content* (B), *material* (C), and *waste management* (D), and the main theme of context gathered the topics of *supermarket* (E), *home* (F), and *people* (G). Table 2 shows the numbers of topic mentions in the 22 categories, and Figure 2 shows the distribution of the seven topics into rounds.

The topic with the highest number of mentions was packaging, followed by the topic of supermarket. The topics of packaging and packaging content were covered in all 13 rounds; super-

Table 2. Mention frequency of topics according to rounds.



market and people were covered in 12, and material and waste management were covered in 11. The topic with least coverage was that of home, as this was used for supporting the exploration of secondary uses for the SRP. Discussions in five rounds covered all seven topics, discussions in six rounds covered six, one round covered five, and one round covered four topics. The rounds with the lowest numbers of topics covered, involved more converged discussions.

The discussion content can be summarised as follows. In Round 1, the speaking participant mentioned difficulties she had as a former supermarket employee, in preparing shelves by placing small products one-by-one, thus suggesting "multipacks" (packaging with multiple products). In Round 2, the speaking participant mentioned user experience, informing the group that baby food jars are generally bought in quantities and in different flavours. Hence, the *packaging* concept of "combination multipacks" was raised and carried into the discussions. Discussions on the topic of *packaging* included descriptions of SRP examples available in the market; protection of the packaging content from factory to market; and *modification* possibilities for using the packaging during shopping, shelving, and storing.

Discussions on the topic of *pack-aging content* included alternative jar shapes and sizes; space saving; standing out among competing brands; ensuring visibility of jars; and providing product information for consumers.



Figure 2. Distribution of topics according to rounds.

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Discussions on the topic of *material* included material properties; production standards for corrugated cardboard (CC); advantages and disadvantages of glass food packaging; providing sturdiness of packaging; avoiding excessive usage of material; avoiding material wastage during shelf set-up; and avoiding additional packaging material. Discussions on the topic of *waste management* included reuse possibilities of waste CC; recycling of the packaging materials; and deposits on boxes.

The *supermarket context* was depicted as a competitive shopping environment where the person spends time in front of shelves to interact with the packaging. Discussions on the topic of *supermarket* included the logistics process of SRP; *displaying* the SRP and its content; and arranging shelves for accessibility, categorisation, and brand distinction. Discussions included *product marketing* strategies such as displaying in original ways, and giving collectible gifts in the packs.

Discussions on the topic of *home* were on ways of *storing* the jars and space saving. Discussions on the topic of *people* included easing the stackability of packs and arrangement of shelves for *market staff*; attracting the *consumer* who has limited time for shopping and is environmentally sensitive; and providing easy interaction for the *user* with the packaging for removing, carrying, and storing jars.

4.2. Solution areas

Three main themes gathering seven solution areas were determined from the discussion content (Table 3). For the theme of *packaging design*, the solution area of *features of the packag*ing covered ideas for box-type packaging for many jars; irregular-shaped packaging allowing removal of single jar; unusual box shapes for arranging jars in different ways; and boxes with openings to see the jar content inside. The solution area of features of the packaging components explored ideas for flaps, covers, handles and base, with solutions offered for structural reinforcement, stackability, jar protection, and jar stabilization.

For the theme of *product marketing*, the solution area of *packaging concept*

covered ideas for combination multipacks with three to six jars, for daily or weekly nutrition; trial packs; packs that can be combined with other types; and fill-in-yourself packages. The solution area of graphical solutions on packaging and jar labels explored ideas for visibility of food type and product information; identifiability and brand competition; and food categorisation of jars on shelves. The solution area of *sustainability concerns* explored ideas for layout designs avoiding production and set-up waste; and reusing empty packaging for shopping and storing.

For the theme of *modifiable packaging*, the solution area of *modifying for packaging-related uses* explored ideas for the modification of the packaging or its parts by the consumer during shopping, such as combining packs of different contents; removing empty parts of packaging; expanding a folded package to fill in with jars; and tearing off part of pack to purchase in less amount. The solution area of *converting into other uses* explored ideas for

Table 3. Solution areas and their sub-categories.

Packaging Design (60)	Features of the packaging (25)		
	Features of components (35)		
	Packaging concepts (11)		
Product Marketing (45)	Graphical solutions (19)		
	Sustainability concerns (15)		
Madifiable Daduation (42)	Modifying for packaging-related uses (18)		
woomable Packaging (42)	Converting into other uses (24)		

Table 4. Types of statements and their sub-categories with examples (Participant Code, Round No.).

Information Statements (69)				
Fact (12)	Amount of baby food changes as baby grows. (PF, R2)			
Observation (13)	Some parents take notes of what their babies eat. (PF, R6)			
Presumption (14)	Not used every day, emergency food. (PD, R2)			
Description (verbal 9)	Plastic parts that hold together six-pack drink bottles. (PC, R3)			
Description (visual 21)	Drawing of a plastic apple tray. (PA, R11)			
Problem Statements (61				
Actual situation (38)	Cardboard looks cheap and messy; thick, not slick. (PI, R13)			
Probability (12)	Could be hard to arrange recycling as it involves different materials. (PK, R10)			
Query (11)	If you buy one jar, what about the remaining package that rests on the shelf? (PM, R9)			
Objective Statements (7	5)			
Aim (38)	Should be easy to categorise in the market shelves. (PM, R2)			
Design suggestion (19)	The design may allow the user to store boxes easily at home. (PM, R5)			
Directive (12)	Baby food has to be seen easily and directly. (PG, R2)			
Constraint (7)	Corners of multipacks need to be protected. (PK, R7)			
Affirmation Statements	(59)			
Approval (38)	Breakfast, lunch and dinner together 3 jars is a good idea. (PJ, R6)			
Consequence (14)	Will lessen trash. (PE, R6).			
Repetition (verbal 5)	Labels are important. (PG, R2, referring to PB's think aloud statement)			
Repetition (visual 2)	2 drawings of a mineral water bottle handle for 6 (plastic piece). (PM and PK in R3,			
hepetition (visual 2)	referring to PC's think aloud statement)			
Criticism Statements (74				
Disapproval (31)	Selling with a box is not an efficient idea for those who need only one. (PG, R1)			
Concern (30)	Will depositing be cheaper than using new jars for the producers? (PD, R7)			
Suggestion (13)	How people store at home should be explored. (PA, R5)			
Concept Statements (74)				
Ideational (36)	Multipacks containing many jars may be offered for customers to buy whole pack. (PE, R1)			
Directional (verbal 31)	Categorisation according to a) brand; b) kind of ingredient and c) size. (PM, R2)			
Directional (visual 7)	Drawing of a board game with pieces. (PA, R11)			
Solution Statements (72)				
Partial (verbal 30)	Turn the frontside of the package so that the content inside will be visible. (PL, R4)			
Partial (visual 15)	Drawing of a foldable handle that also allows stacking on top of each other. (PA, R9)			
Whole (verbal 5)	Package should turn into a table to take regular notes and might be collectable. (PA, R6)			
Whole (visual 22)	Drawing of an inclined box with sliding jars. (PM, R12)			

Table 5. Judgment over input and output statement numbers according to rounds.

	Input	Judgment	Output	Judgment / (Input + Output)
R1	28	9	5	0,27
R2	24	10	7	0,32
R3	17	12	3	0,60
R4	18	11	10	0,39
R5	15	8	9	0,33
R6	13	11	13	0,42
R7	14	7	8	0,32
R8	11	15	11	0,68
R9	22	8	7	0,27
R10	12	6	8	0,30
R11	12	17	20	0,53
R12	11	12	23	0,35
R13	9	7	22	0,22
		400		

modifying empty packaging for different uses such as decorations and timetables; and turning waste CC into toys such as houses and board games.

4.3. Statement types

Seven main statement categories with 21 subcategories were identified for the 485 statements as information, affirmation, criticism, problem, objective, concept, and solution (Table 4). Information statements were those providing information on various aspects of the problem area. Affirmation statements were those indicating agreement on the input provided during discussions. Criticism statements were those bringing critical arguments to input requiring evaluation. Problem statements were those identifying a problematic issue in an input. Objective statements were those suggesting a design direction to follow. *Concept* statements were those offering an idea to pursue for the design solution. Solution statements were those describing a tangible design solution.

From these statements, those indicating *information*, *problem* and *objec*- *tive* were taken as input (what participants provided as discussion content), those indicating *affirmation* and *criticism* were taken as *judgment* (what participants thought about discussion content), and those referring to a *concept* or *solution* were taken as output (what the participants generated as design ideas). How these statement categories distribute into the session was determined in order to display the change in the ratio of *input*, *judgment* and *output* statements according to rounds (Table 5; Figure 3).

It was seen that the number of input statements was high in the first rounds and gradually dropped as the session progressed. On the other hand, the number of output statements was low in the first rounds, and increased as the session progressed. This indicates that to be able to generate ideas, the participants first provided input for the discussions. As the session progressed, context related input accumulated; therefore, participants were able to use a lesser number of input statements and instead generate a higher number of output statements.

Judgment statements, on the other hand, were used at a regular level throughout the session. The highest number of *judgment over input and output statements* was obtained in Round 8 (r=0,68) indicating that evaluation dominated the discussions. In the following Round 9, the number of input statements increased, indicating an effort for reframing discussions. The lowest ratio of *judgment over input and output statements* was obtained in



Figure 3. Distribution of input, judgment and output statements according to rounds.

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the final Round 13 (r=0,22) indicating minimum level of evaluation. The highest numbers of output statements were generated in the final three rounds. Frame establishment, saturation of discussions, and anticipation of the end of the session may have played role in reaching a peak in idea generation.

4.4. Problem frames

Following, a timeline was prepared for displaying the interrelation between input and output statements offered by the speaking participants in the sequence of rounds (Figure 4) in order to identify the paths through which the problem frames developed. The timeline was cross-checked with the discussion topics produced for each round.

It was seen that the group adopted the two separate themes offered in the first two rounds of discussion and built on them as parallel frames. The pattern that appeared indicated that speaking participants began with providing input to the discussions, followed by output (10 out of 13 rounds). Based on content accumulation in the first three rounds, the speaking participant in Round 4 generated solutions only, for the two frames. In Round 5 that followed, the speaking participant built on the content by providing input only. Starting from Round 5, five out of nine rounds contained input for both frames. In Round 8, input for another frame was offered, together with output responding to it. This attempt did not find support and the frame was discontinued once that round ended. The discussion pattern of input first, output next continued in the remaining rounds.

The analysis contributed to the tracing of the patterns of topic, category and subcategory interdependence, revealing the following two problem frames. Frame 1) Re-usable Combo-multipacks: The consumer, who has limited time for shopping, identifies the preferred brand on shelf, locates the types of food from among the stacked packs, buys a ready combo-multipack or prepares one at the supermarket and uses the packaging for the storage of jars at home. The packaging is returned to the market for a deposit, or can be reused as a personal baby food jar carrier. The prioritised objective of this frame was *marketability*.

Frame 2) Minimum Production Waste with Post-use Possibilities: The packaging is manufactured with minimum production waste, transported to the market, stored on top of each other, placed on the shelves in special arrangements, removed using a handle, carried home and stored. The packaging has post-use possibilities in the home, and all materials involved are recyclable. The prioritised objective of this frame was *sustainability*.

Frame 1 found most coverage. In four rounds (6, 7, 9, 11), the generated output was a mixture of solutions that addressed both frames. In Rounds 6, 7 and 11, input was related to Frame 1, but output combined ideas generated for both frameworks, with links to past ideas offered for Frame 2. In three other rounds (10, 12, 13), output addressed both frames separately. As this was towards the end of the session, it can be said that the established problem frames had matured, making it easier for participants to generate distinct solutions for each.

5. Discussion: Design reasoning strategies for effectiveness

The findings provided insights into the design reasoning strategies employed by the participants of the brainstorming session for content



Figure 4. Interrelation between input and output statements in sequence.

creation, problem exploration and idea generation, with reference to the productivity indicators of divergence, convergence, quantity, situatedness and goal-orientedness.

5.1. Content creation

Content creation was the efforts of participants in making relevant contribution to the discussions by providing problem-related input and being actively involved in the discussions. This effort was facilitated with the systematic procedure followed for brainstorming, expecting the contribution of all, and allowing both nominal and interactive brainstorming. The following strategies were identified for content creation.

5.1.1. Relevant contribution

Offering input to the discussions first, for the output to follow (situatedness): Participants set the grounds for ideas first; they supplied discussion content with information related to the problem context that could provide justifications for design ideas that followed, and also principles for assessing them.

Providing individual interpretations based on diverse information sources (goal-orientedness): Participants made effort in diversifying the input they provided in each round, talking of different aspects of the design problem. These included descriptions, opinions, criticisms, suggestions and enquiries related to the problem area, in the form of personal experiences, observations, accounts of knowledge on topic, and scenario building.

5.1.2. Active participation

Reinterpreting the problem from individual perspectives (divergence): Each new round was an opportunity for the speaking participant to reinterpret the brief from own point of view and display own understanding of the problem in relation to the discussions made so far, setting context for the discussions of that round.

Adopting a role for the type of contribution made to the discussions (situatedness): Participants adopted roles (Cross, 2011; Brereton et al., 1996) as they offered input in each round, for the sake of the discussions. For example, while Participant A who volunteered to begin the session in Round 1, contributed with her experience as an ex-supermarket employee, Participant B in Round 2 contributed with her observations of her sister who at the time had a young baby. Based on the direction of the discussions, Participant G in Round 7 felt the need to remind the group of production constraints for cardboard packaging. Participant H in Round 8 offered provocative ideas that she knew would stir up the discussions.

5.2. Problem exploration

Problem exploration was the efforts that participants made in problem framing and problem naming, for ensuring that the discussions provided a complete picture of the context and situated the lines of thought, and the participants collectively identified problem frames and agreed early upon a main concept, thus setting grounds for relevant idea generation. The following strategies were identified for problem exploration.

5.2.1. Problem framing

Defining sub-problems to frame the problem comprehensively (divergence): Participants made effort in stepping out of the initial problem frame (supermarket) and varying the problem frames. For this, the problem area was broken down into sub-problems that included environments, props, people and functions, and that defined stages of usage (i.e. manufacturing packs, storing and transferring packs, opening and setting-up packs, arranging shelves, locating preferred products, reaching jars, preparing packs for purchase, transferring from supermarket to homes, storing, and managing waste). Re-framing the problem through these sub-problems in new rounds allowed covering a comprehensive product usage and life-cycle process, and diversifying content input.

Revising discussions from earlier rounds (convergence): Every few rounds, participants made a review of the discussions, acknowledging progress in reference to ideas generated so far. This was done to check the direction of discussions and keep in track with the brief; and also, to review the ideas and pick those that could be

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built on. This ensured continuity of the lines of thoughts and building of the frames.

5.2.2. Problem naming

Using complementary problem frames for exploring the problem area (divergence): The session revealed two problem frames representing parallel lines of thought (Lawson & Dorst, 2009; Lawson, 2000). Frame 1 (packaging solutions for marketability) was more addressed within the session, as this was the main problem area defined for the brief. Frame 2 (packaging solutions for sustainability) was treated as complementary, and incorporated aspects of the problem area that seemed to require attention for a number of participants, but could not somehow integrate into Frame 1, therefore running in parallel instead of being discarded.

Collectively naming project objectives for a common understanding (goal-orientedness): The design brief did not indicate any project objectives. It was seen that participants required the guidance of such higher principles (Cross, 2011) in order to help name the problems to be explored. The participants collectively determined the project objectives successively (naming "marketability" half-way through, and "sustainability" towards the end), while building the problem frames in parallel from the start.

5.3. Idea generation

Idea generation was the effort that participants made in expanding the solution space by offering numerous and diversified ideas for design solutions that matched the problem frames. For this, participants strived for situating the design ideas within the two problem frames, and diversified the design ideas by decomposing and revaluating them as discussions progressed. Performance in idea generation made the productivity of the session more evident in terms of quantity. The following strategies were identified for idea generation.

5.3.1. Situating design ideas

Aiming for solutions while exploring the problem (goal-orientedness): Participants were solution-oriented (Kruger and Cross 2006). They offered design ideas from the first round, based on problems that the speaking participant described, which in turn provided discussion material and helped participants in exploring the problem while generating solutions for it (problem-solution co-evolution).

Agreeing early on the main concept for a common goal (convergence): An evident strategy for idea generation was the early establishment of the main concept of "combo-multipacks" in Round 2. Participants readily adopted this concept because they had already started idea generation in Round 1 ("multipacks for many jars"), and the speaking participant in Round 2 had picked up on the ideas from a different aspect ("combination of jars with different ingredients") adding further value. The willingness of participants in adopting this concept allowed them to frame the problem from their perspectives and offer variations of this concept as ideas to elaborate on.

Interrelating concept and context for idea generation (situatedness): Discussions were an interrelation of both context (e.g. environment, user, situation) and concept (e.g. multipack) in each round, which also made evident the exploration of the problem area together with the design solution. Participants supported idea generation for the design concept with descriptions of the context, which helped situate the ideas, justify the reasons for offering them, evaluate them for alternative suggestions and improve them.

Using judgment to keep on track (convergence): Participants used judgment in both problem exploration and idea generation. Judgment included affirmation (positive evaluation) as well as criticism. Individual documentation of the discussions allowed to be critical for later on rather than immediately speaking criticism out loud, and instead, constructively process the discussions. Therefore, during the interactive discussions that followed individual documentation, the group collectively built on ideas in reference to past discussions, and from time to time used mild criticisms for deadends (e.g. design ideas for shelves), to keep on track with the design brief. The main project objectives (i.e. marketability; sustainability) were the leading points of reference in judgment, among others (e.g. manufacturability, stackability, safety, accessibility).

5.3.2. Diversifying design ideas

Decomposing the concept for generating alternative design solutions (divergence; quantity): The main concept was decomposed into components (e.g. box, cover, flap, base, handle, inner separators) for exploration, leading to the generation of many ideas for packaging features. These partial ideas formed a pool from which to improve, transfer or combine into alternative design solutions during discussions.

Running parallel lines of thought for extending the solution space (convergence; quantity): Participants used the two problem frames simultaneously to follow through the development of diverse design ideas, complementarily and in reference to one another. This is known in design theory as using parallel lines of thought (Lawson, 2000; Lawson & Dorst, 2009).

Reinterpreting out-of-the-frame ideas into frame-relevant ideas (situatedness; quantity): Participants showed determination in keeping within the problem frames. They refused to pursue an alternative track suggested more than half way through the session in Round 8 (i.e. elimination of packaging altogether; changing jar material and cap shape), but instead of eliminating the ideas offered in that round, they processed them into usable outcomes (e.g. detachable silicone jar caps transformed into detachable CC packaging for groups of jars). The frames ensured continuity of ideas with links to the past.

6. Conclusion: Design reasoning process in the session

This paper attempted to address a gap in the literature in explaining design reasoning in creative group discussions, by establishing a theoretical framework for interpreting the findings of analyses carried out on the documentation of a nominal and interactive brainstorming session. The aim of the analyses was to identify the strategies that contributed to the effectiveness of the brainstorming session. The framework set the grounds for interpreting the discussion content in identifying the design reasoning strategies used by the session participants, and explaining the collective design reasoning process that took place.

The Controlled Input Method as the brainstorming technique used, required the structured participation of all participants, allowed them to think aloud on the topic for which design solutions were sought, carry out nominal brainstorming as well as interactive brainstorming systematically, and use their judgment privately to process the discussions, supported with visual thinking, after which they could offer them interactively. This process has provided a rich documentation for the discussions, as they were filtered, processed and built on. A total of 15 design reasoning strategies were identified, used by the session participants for content creation, problem exploration and idea generation. The design reasoning strategies helped to initiate and steer discussions, actualize context-relevant idea generation, ensure continuity within problem frames, and constructively evaluate ideas, acting as factors for the effectiveness of the brainstorming session.

The collective design reasoning process of the brainstorming session described in this paper can be explained as follows. As expected from the brainstorming technique used, speaking participants began their rounds by contributing their partial knowledge and experience on the topic, and understanding of the design brief. These individual interpretations acted as the various individual frames through which participants collectively extended the problem area. The participants showed tendency in first providing contextual input, then offering conceptual outputs, and this continued throughout the rounds. Adopting a solution-oriented approach, participants established and agreed upon the main concept early in the session, displaying convergent thinking. The concept was broken down into its components during discussions, in order to generate partial design solutions, displaying divergent thinking. While doing so, participants explored the solutions based on context descriptions and usage situations, which contributed to the construction of two alternative problem frames describing

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life-cycles and usage processes for the final solutions. This in turn led to the identification of prioritized objectives forming grounds for the collective judgment of ideas carried out regularly, and keeping discussions on track. The process resulted in the generation of design ideas that concentrated on three major solution areas responding to these problem frames in the light of the prioritized objectives, thus making this an effective brainstorming session.

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Determination of the structure of the project based studio courses for the education of interior design bachelor

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Abstract

In order to develop interior design bachelor education on national scale, it is necessary to structure teaching methods and course contents within the framework of international professional qualifications. For this purpose, in this study, the most intensive courses which has the highest course hours in the interior design curriculum were discussed. In this paper, it is aimed to examine the structures of design studios in interior design departments accredited by organizations that determine professional qualifications and to create comprehensive data on their contents. The relevant course data for two interior design departments accredited by the CIDA organization in the USA and four interior design departments accredited by national accreditation organizations in Europe were obtained for study. The course contents were classified by coding in content analysis approach. The data obtained will be compiled under four headings: "content", "subject", "skill" and "output" for each studio level. As a result, comprehensive and categorized tables was created for each studio level, containing current design issues and studio methods, which can be used as a suggestion for structuring interior design studio classes.

Interior design, Interior design education, Interior design studio, Studio learning, Design learning.

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1. Introduction

In order to train professionals who can have the requirements of the twenty-first century and use the necessary knowledge and skills effectively in accordance with international standards, it is necessary to develop the programs nationally in interior design education. For this purpose, it was foreseen that the contents of the design studio, which constitute the most intensive course group in interior design programs, should be developed. The interior design department in Turkey, the interior design studios in terms of the content of project given is known to be addressed in the course of so many different issues and design problems. Developing the project course contents in accordance with the current situation in the world is a constant requirement. It is observed that the design problems discussed around the world change on average every 5-10 years. Consequently, the lack of knowledge sources containing comprehensive and up-to-date project course content recommendations was noticed. The main purpose of the study, thanks to the course contents belong to the sample schools accredited by the organizations of professional qualification, it was aimed to develop interior design education in Turkey and to improve it by contributing to the current structure. In this respect, it is significant to integrate the current design problems that the project courses should include and the current solution approaches to be produced for these problems into interior design curricula. For this purpose, it is aimed to collect the project-based studio course contents of the sample schools under certain themes. The criterion is that the sample schools are accredited by CIDA or the national accreditation bodies in Europe. In this respect, the schools whose data are available are from the USA and Europe. For this, the studio course content texts are brought together and the texts are divided into sub-categories that make up the whole structure according to their content. In this way, a guide will be created that includes current topics, contents, and methods that can be used in the planning of interior design studio courses at regional and international levels.

For this purpose, the research questions of the study mainly focused on the contents of the design studio courses. It is aimed to answer these questions within the framework of interior design professional standards. In interior design education;

- What are the current design issues in the world that can create content for the interior design studio?
- What topics are currently being discussed in interior design studios in the world?
- What skills are gained in interior design studios in today's world?
- What kind of outputs are expected in interior design studios today?

Within the scope of this study, the answers to these research questions were tried to be formed, the current design problems that were discussed in the studio courses in recent years were revealed, and the themes related to the current issues were reached. Knowledge was gathered about what skills were gained through studio classes and what kind of outputs were achieved at the end of the learning process in these studios.

In Turkey, due to the lack of a body that has the authority to accredit interior design departments today as it does in the United States, creating a resource that is referenced as a directory for interior design education was found crucial. Thus, the findings of the study could contribute to the field with the accreditation process, which was so important in terms of higher education qualifications. Within the scope of the study, the table including the most up-to-date international regulations in the field of interior design; was created according to the professional qualifications contained in the European Council of Interior Architects (ECIA) 2013 report and the professional standards determined in 2020 by the Council for Interior Design Accreditation (CIDA). A framework will be provided and the data obtained from the schools will be interpreted in the light of this knowledge. The content will be created as a result of project proposals, to be a resource for the interior design program in Turkey aimed at helping the development of interior design and updating training programs.

2. Design studio and learning processes

In interior design education, studio education applies the learning method known as "project-based learning" in the literature in terms of practical outcomes. Project-based learning includes user-focused tools. With an emphasis on learning rather than teaching, project-oriented programs are recommended for students to learn self-management, manage their time and resources, and therefore better prepare for professional practice (Altay, 2014). "Project-based learning can be defined in various ways with different educational disciplines and levels. Projects are frequently used in K-12 level education, so it is a concept and teaching method that most students are familiar with" (Mills & Treagust, 2003, 8). Interior design studios are a project-based, student-centered and practice-oriented learning environment where it is aimed to provide the student with the necessary competencies for a graduate interior designer. "Without a doubt project studio is the essence of the professional Education" (Cordan et al., 2014, 191). Ledewitz (1985) states that the lack of clarity over the purpose and effectiveness of the design studio reflects its complexity as a teaching or learning. Though the design studio is the main tool in teaching the main elements in design education (Ledewitz, 1985). The first of these is that students acquire presentation and visualization skills. Another is that students learn the professional language. Exploring and explaining ideas through drawing is a new experience for students. Through the experiences in the studio, the design student gains the power of thinking and expression in design, and at the same time, he can master the common expression language that appeals to all disciplines under the roof of design.

Studio performance in school depends on various factors, but they can be grouped in the following three categories: student characteristics, teacher impact and school properties (Gajda, 2016). Cho (2017) states that there is no relationship between design studio performance and creativity, spatial ability, and visual cognitive style. Also, the evaluation of students' performance

in design studios is different from lectures in which objective tests and exams are conducted. Different from lecture courses, where objective exams and tests are used to measure student performance, but in design studio, it is measured by assessment of students' design process and outcomes according to the learning objectives of the course (Cho, 2017). The learning of design is reinforced by the design process experienced in the studio environment and internalized by the student. Active components to realize an effective studio communication: "design studio as a communication medium", "design task or problem", "design knowledge" and "different communication environment" and people "student designers and studio instructors" (Paker-Kahvecioğlu, 2007). Schön defines that in design processes, the concept of "reflective practice" emerges when there is an indirect response to situations of uncertainty, imprecision or uniqueness within the actions of "knowing-in-ac-"reflection-in-action" tion", (Schön, 1987) and "reflection-on-action" (Webster, 2008; Schön, 1987). "Throughout the design process, the given design problem turns into a design solution, and a continuous dialogue between the student and the lecturer strengthens the design process (Demirkan, 2016, 32)". Kvan (2001) explains that design teaching usually begins by posing a design problem that includes project features, program attributes (duration, outputs) and objects (Kvan, 2001). Design education includes lectures and studio teaching to engage students with design knowledge, skills and applications (Sagun et al, 2001).

According to Demirbaş and Demirkan (2003), most of the recent work on the design studio is based on computer-aided design or distance learning. "Some other work involves the design studio as an environment or the process in the studio" (Demirbaş & Demirkan, 2003, 437-438). There are some studies that examine many questions related to shaping the future of design and engineering (Smith, 2008). As emphasized in the literature, project courses which are the equivalent of project-based, practical learning methods in interior design education, are of primary im-

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portance in educational programs. In addition, although there are many studies about project-based education and studio teaching in design education in the literature, there is no scientific study that directly touches on the importance of up-to-dateness in interior design studio content, discusses the course contents of the projects or offers up-to-date content suggestions. In these respects, this study is expected to fill the gap in the literature.

3. Professional competencies for interior design

The central theme of interior design is the human interaction with space^{1,2}. Contemporary critical spatial practice is created on three layers: physical space also defined "perceived environment", mental space which is imagined, designed and planned and social space that includes human activities and communication.



Figure 1. The relationship of three areas of space [1].

Interior design is also defined by the concept of space design-space within the built environment, ephemeral space that appears and disappears, and meta-space that only exists in digital form¹. Kaçar (1997) states that interior design consists of practical, aesthetic and functional requirements (Kaçar, 1997). Today, the profession of interior design is complex and is not limited to choosing colors and tiles, it expands to include communication, business, and management (Hernecheck et al, 1983). There are different professional definitions of interior design in the literature, but it can be said that it is a profession and a design discipline that directly affects human life in general and shapes human life.

As in every field of education, there is a need for updating learning strategies and structuring training programs in design studio learning. Educators are constantly reviewing the curriculum and course structures to keep abreast of changes in their field. The updating process helps educators to better meet the needs of the individual and the profession (Myers, 1982). When the education programs are examined, differences are observed even in the education programs of a particular field in the country. Professional organizations and some accreditation organizations are working to standardize the education process, to search for education quality and compliance with various criteria. Through these organizations, there is an international discussion and partnership of professional practice analysis and training programs accreditation.

To renew and improve the curriculums, course contents and program the concept of competency should be questioned. It can be deduced that Bloom interprets the concept of competence as a set of knowledge, intellectual abilities and skills necessary to cope with problems (Bloom, 1956). In interior design studio, it is aimed to provide the student with the necessary competencies for a graduate interior designer. Foundation of Interior Design Accreditation (FIDER), which is an important institution that determines professional competencies in the field of interior design in the world, was established in 1970 in the USA to determine interior design professional standards, and after 2006 it was named CIDA. In Europe, ECIA, the common platform of European Union member countries in the field of interior design, was established in 1992. The criteria set by CIDA cover professional responsibilities in the widest way and provide qualifications for evaluation of training programs. Likewise, the Higher Education Qualifications Framework (TYYC) in Turkey cannot provide training program evaluation and defines the knowledge, skills and competencies that professionals should have (Özsavas & Güler, 2012).

The table that shows interior design professional standards (Table 1) is a

Cultural Values and Responsibilities	Technical Skills	Creative and Social Skills	The Quality of the Education
Global perspective	Professional practice and project management	Design process management	Compliance of the content of the training with the professional qualifications
Human-focused	Visual presentation and expression skills	Creative problem solving / Creative thinking	Accreditation
Professional ethic	Knowledge of material and detail	Collaboration skills (interdisciplinary, intradisciplinary)	Supports (Physical equipment, financial resources and locations)
Historical and cultural responsibility	Knowledge of environmental systems	Verbal and auditory communucation skills	Quality of academic human resource
General design theory, technology and the knowledge of humanities	Knowledge of structure and fine structure	Space and form competencies	Identity and context
Innovation culture	Knowledge of regulations and codes	Aesthetic use of color	
	Knowledge of color (technical)	Critical and analytical thinking	
	Manual or digital drawing, drafting	To follow innovations	
	Design research and documenting	Ability to manage art and design principles in a broad social and cultural perspective	
		Empathy	

 Table 1. Interior design professional standards according to CIDA 2020 and ECIA 2013, 2020.

result of content analysis. In the first stage of analysis, the sections related to professional standards or qualifications in the reports were read carefully and the common concepts in the reports were tried to be reached. To compose the table, the thematic coding had been made by authors over these documents to analyze the contents. Briefly, it was formed by the translation of the CIDA Professional Standards³ and the "qualifications" part in the ECIA 2013 and 2020 report^{1,2}.

The professional standards (Table 1) were created to evaluate the accredited interior design schools in the study findings during the interpretation of the course contents. It is known that, in line with the Bologna process in Turkey, the main fields are determined within the scope of TYYÇ created by the Turkish Higher Education Council (YOK). However, it is seen that the standards of the interior design profession are not adequately represented in this structure. In addition, the creation of this table (Table 1) can contribute to the development of TYYÇ at the national level.

4. The study

Within the scope of this research, it is tried to reveal the analysis of the project-based studio course contents of the schools considered as examples and aims to reveal the structure of the studio courses and the current design problems examined based on the analysis. The structure of the study was illustrated with a diagram that sums up the process is below (Figure 2).



Figure 2. The scheme of model of the study.

The subject of the study is the project-based design studios, which are the most intense class groups in terms of course duration and content in the curriculum of interior design bachelor departments. In three or four years of bachelor study interior design or interior architecture departments in Turkey

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and the other countries, in the last two or three years (2nd, 3rd and 4th grades) the studio courses are available. Interior design studios generally have the characteristic of being the highest course hours and credits of each semester in the departments of interior design. Although there are courses in a studio environment similar to the design studio in the first year, however interior design project courses are generally starting from the second year. Design studios, in schools in Turkey and abroad are generally named, "interior design project" or "interior design studio". Within the scope of this study, the contents of the design studio course, which constitute the important building blocks of the interior design education program, have been gathered together as the study subject. In this research, the fact that the schools determined for this study are accredited by official institutions has been the selection criteria for reasons such as reliability and transparency. For this reason, schools accredited by CIDA in the USA, which is the authority on professional qualifications, and ECIA in Europe, or by national accredited institutions shaped according to the values of this structure, were selected. In the next stage, schools whose catalog data can be accessed on the web were searched separately, and a study was carried out on a sufficient amount of samples that could be accessed for research.

4.1. Method

This research aims to reveal new scientific knowledge about the structure of the studio courses by the content analysis method. From this perspective, the research design of this article is based on "epistemological assumptions" aimed at creating knowledge from an ontological point of view, it has a Post-positivist perspective depending on being qualitative research and is based on an interpretive paradigm. Within the scope of the question of how can be made new knowledge, it is aimed at creating scientifically based knowledge in the field of design education. Due to the internal dynamics of qualitative research, the study is based on the principle of induction in generating knowledge.

In the study in which the content analysis method was used, "category analysis" was carried out with the coding technique in qualitative research. The course contents in the text form were tabulated and analyzed with the method of content analysis based on the principle of converting words and sentences into meaningful codes. The content analysis method is used in the meaning of "scientific semantic analysis of qualitative data brought into text form". Content analysis; is a research technique used to draw systematic and unbiased conclusions from certain characters defined in the text (Stone et al., 1966). This technique is based on the production of valid comments from the text through a series of processes. These comments are about the sender of the message, the message itself, and the recipient of the message (Weber: 1989). In the study, sub-themes under the main themes created in accordance with the content analysis method by coding in qualitative research were reached by using the course content texts. NVivo 12 software program was used to analyze the data. By evaluating the data based on the codings obtained in the content analysis, sub-themes of each studio level were reached under four main themes determined by the researcher. In accordance with the qualitative research principles and nature, the coding phase was carried out by focusing on the essence of the research and considering the integrity of meaning. With this perspective, a sub-theme repeated once in the text was included in the study findings.

4.2. Data collection and procedures

All data in document form were collected through the official websites of selected schools. In Table 2 below, detailed information of the selected institutions and departments is available.

The schools were selected among the websites including all contents of courses. To be able to reach the detailed contents from the websites is a significant limitation of this study. After the data collection, all documents that were reached were translated into Turkish in the scope of the study.

The research universe is composed of interior design departments that are

Table 2. Information about the sample group departments.

Place	Institution	Department	Degree	Duration
EU	IED Florance Istituto Europeo di Design	Interior Design	Bachelor of Arts	3
EU	IED Rome Istituto Europeo di Design	Interior Design	Bachelor of Arts	3
EU	Berlin International University of Applied Sciences	Interior Design	Bachelor of Arts	3
EU	Hochschule für Technik Stuttgard	Interior Architecture	Bachelor of Arts	3
USA	NewYorkSchoolofInterior Design	Interior Design	Bachelor of Fine Arts	4
USA	Savannah Collage of Art and Design	Interior Design	Bachelor of Fine Arts	4

accredited by authorized institutions and organizations in the USA and Europe. In the study, in which a qualitative research perspective was adopted, the sample group was limited to six interior design departments in total, which were predicted to have the criteria that could represent the universe. To determine the most up-to-date course content in the field of interior design on an international scale, two different departments accredited by the CIDA organization in the USA and four separate departments accredited by different national accreditation organizations in Europe were determined for data collection. School selection criteria; the fact that they have been accredited by the national accreditation bodies including CIDA in the USA and ECIA in Europe, and the design studio course contents can be accessed completely. It has been observed that among the interior design departments, the detailed contents of course on the websites are quite limited. According to the preliminary study conducted within the bachelor education period of three or four years of interior design departments, it is known that there are a total of four or six-level design studio courses in a department program. For this reason, different numbers of interior design studio lessons were reached from each school. For example, while there are four or five design studio courses in threeyear schools in Europe, it has been observed that there are six level design studio courses in a four-year program in the USA. The amount and density of data in the documents obtained were deemed appropriate and sufficient for the use of the content analysis method in qualitative research by researchers.

4.3. Data analysis

For the analysis of data, the inductive analyses approach was used for this research in the context of qualitative research perspective. The inductive analysis involves the discovery of themes, patterns and categories within the data. From this perspective, in the first stage of analysis, the data were read several times by the researchers to find the meaningful group of words that can be a code, and then the content analysis was applied via open coding in NVivo12 software. After the open coding phase, the patterns were found and then was reached the themes and sub-themes. In the process of determining the themes, it was checked whether the expressions under each theme were coherent with the sub-theme.

To increase the reliability of the study and to prevent data loss, the links of websites or the document files were recorded according to the date of access. To copy, arrange and save the contents excel tables were used. After this phase,

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 Table 3. "Content" recommendations for design studio levels.

	Studio Level 1	Studio Level 2	Studio Level 3	Studio Level 4	Studio Level 5	Graduation Thesis / Final Studio
Content	-brief oriented design solution -building theory, planning and project work - environmental relations and perception -exploring people and space -practicing the basic design methods and conceptual processes	-creative and design basics -design and research with conceptualization -design thinking methods -design for all -intensive workshop -spatial organization, construction of typologies and forms of spaces	-documentation and communication -furniture -innovation processes and technology	-basic museology and exhibition design -collaborative practice -simulation of the professional experience	-design thinking for innovation - interdisciplinary course (with product design)	-bachelor thesis -professional simulation -self determined project type -synthesis of the whole training

they were transferred to NVivo 12 software program for analysis. Different code and theme alternatives in the process were discussed, and the agreed points were taken as a basis in determining the themes.

5. Findings

As a result of the qualitative coding stage on the data of the accessible design studio course content belonging to six different interior design departments, the "four meta-themes" formed by the content data showing similarities in the departments were determined. These are: "content", "skill", "topic" and "output" themes. The findings of the study were reached by entering the relevant codes under each main theme. The findings resulting from coding constitute course content recommendations for design studios that can be used at the national level.

5.1. Findings of "content" for design studio levels

The "content" meta-theme primarily includes information such as which approach the design studio is designed with, the method used in the studio, and what kind of skills have been acquired. Current design approaches and concepts are positioned under this title. Statements regarding the content accessed from the course content documents were coded separately for each studio level. After these codings, it was seen that the processes related to human and space relation, environment relations-perception and concept determination came to the fore for the 1st level studio course. For the 2nd level studio, concept development, research and design thinking methods can be summarized as design / inclusive design for everyone and basic design approaches. For studio level 3, both the documentation research, furniture, technology and innovation processes are emphasized. In the 4th level studio, professional experience simulation is encountered for the first time in terms of museology and exhibition, collaborations and content. Design thinking, innovation and interdisciplinary work have gained importance in the 5th level studio. Table 3 below shows the sub-themes revealed under the "content" meta-theme.

Finally, the last of the studio is often referred to as the graduation project in the departments of Turkey, as often seems to be a thesis content in the sample departments of this study. It is a project study that includes the synthesis of the whole training together with professional simulation. In addition, it is frequently encountered as a course method to determine the project type of the student himself.

5.2. Findings of "skill" for design studio levels

The codes that stand out under the title of "skill" refer to the competencies to be acquired by the student in the project course. In addition, it is a meta-theme that is most directly related to the concept of professional competence or standards, which forms the conceptual framework of the study.

Table 4. "Skill" recommendations for design studio levels.

	Studio Level 1	Studio Level 2	Studio Level 3	Studio Level 4	Studio Level 5	Graduation Thesis / Final Studio
Skill	-assessing client needs, developing a written concept and program -preparing high-quality presentation -principles of proper furniture arrangement -space ergonomics knowledge -to develop and present a program for an interior space with a complex function -to select fabrics, finishes, and accessories -to understand the relationship between human and space -using and analysing	-accessible and universal design knowledge -analysing of human behaviours and needs -to develop and present a program for an complex interior space with different typologies -to develop material, color and lighting concepts -to develop material, color and lighting concepts -to understand the trends of the market -usign design process, programming, planing and presentation tecniques -using documentation for design process	-constructability and integration of electrical, mechanical and code requirements -handling three- dimensional space -identifying the human needs and behaviours -to carry out a survey for research -to develop and present a color, material and lighting concept -to develop socially conscious and sustainable solutions -to express themselves both graphically and verbally -to make detail solutions -user-centred interaction processes -using design thinking advanced tools	-application of human-centric design methodology in interior environments -detail solutions to integrate the technologies are developed -development and representation of a color, material and lighting concept -making scenographic project	-design skills to use in complex projects -knowledge in acoustical comfort -knowledge in code and building analysis, user assesment, programming, conceptualization and presentation -knowledge in innovation and sustainability -knowledge of furniture in technical production, aesthetics, ergonomic needs, material and surfaces -using design research methods -using of furniture in different cultural contexts	-practical realisation of the project and developed detail solutions -prepare existing condition drawings -research and documantation -self-selecting a project type and site and independent design process management

This meta-theme, which can also be expressed with words such as competence and outcome, was chosen as "skill" in the content texts. Table 4 below shows the sub-themes revealed under the meta-theme of "skill".

The skill meta-theme can be summarized as follows for the level 1 studio: requirement program and concept creation, presentation quality, qualified furniture layout, knowledge about ergonomic, textile, accessory and detail selection, understanding human-space relationship, use of lighting and color. In the 2nd level studio course; Accessible and universal design knowledge, analyzing human behavior and needs, preparing and presenting programs for complex interiors, developing material, color and lighting concepts, reading marketing trends and documenting for the design process has come to the fore. For the 3rd level studio; building, electrical and mechanical technical knowledge and requirements, using three-dimensional space with appropriate materials and technology, defining human needs and behaviors, using questionnaire techniques for research, using and presenting colors, materials and lighting, producing sustainable solutions, graphically and verbally. The subjects of being able to express, making detailed solutions, using user-focused interaction processes and using advanced design thinking tools were acquired. For the 4th level studio; the emphasis is on applying human-centered design methodology in interiors, developing detailed solutions integrated with technology, presenting color, material and lighting concepts and making scenario-based projects. In the 5th level studio; ability to use design skills in complex projects, knowledge of acoustic comfort, code and building analysis, concept development and presentation, sustainability and perspective of innovation, technical production in furniture, aesthetics, ergonomic requirements, knowledge of material and surface, use of design research methods and furniture in different cultural contexts are included.

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Table 5. "Theme" recommendations for design studio levels.

	Studio Level 1	Studio Level 2	Studio Level 3	Studio Level 4	Studio Level 5	Graduation Thesis / Final Studio (Studio Level 6)
Theme	-residential -small-scale spaces	-catering spaces -commercial -medical practices, sport facilities -object -office spaces -residence, studio apartment or loft -wellness environments	-complex and diverse residential -professional similation for home -public interiors -system of service	-complex interior in listed buildings -hospitality and service design -museology, exhibition design -private and commercial spaces	-	-complex interiors -furniture based -scenography based -selected project type and site by students

5.3. Findings of "theme" for design studio levels

The title of "theme" is frequently asked by academicians working in the field of interior design and includes information about which project types are selected and preferred for each studio level. Table 5 below shows the subthemes revealed under the meta-theme of "skill".

For example, a student's study of project subjects with different scales, different functions and different requirement programs throughout his undergraduate education constitutes an important richness in terms of design education. In addition, until a student's graduation, it is thought that the diversity of the project subjects in more than one level studio increases the quality of many academics. In the interior design departments examined under this title, only residences and small-scale spaces were the prominent sub-themes for the 1st level studio. For the 2nd level studio, much more various topics have been reached. These are; commercial spaces, medical applications, sports facilities, products, office spaces, residences, studio apartments, loft and wellness spaces. For the 3rd level studio; complex and various functions of housing spaces, professional simulation application for the home, public interior and service system designs have come to the fore. In 4th level studios; It was observed that complex functional interiors, tourism and service design, museum and exhibition, private and commercial spaces were discussed in the given building group. For the 5th level studio, the "subject" theme was left blank as most of the selected departments had six semesters of education. In the department programs consisting of eight semesters, no subject proposal was found for this level. For the 6th level graduation project; complex interiors, furniture-based projects, scenario-based projects, and the project type and area selected by the student were determined.

5.4. Findings of "output" for design studio levels

Under the title of "output" as the last theme determined, it was aimed to reach the details of the outputs such as what the final product to be presented as a result of the studios, in what format and according to which criteria these results are requested, and the scale selection of the models and drawings. For example, some of the interior design departments in Turkey use only 1/50 and 1/100, but it is observed that generally 1/1, 1/2 and 1/5, scales are preferred as the detail scale in drawings or models.

For the 1st level studio under the "output" theme; it was found that the model, 2D and 3D drawings were scaled 1/100, 1/50 and 1/20. In the 2nd level studio; it was learned that model, two and three-dimensional drawing, manufacturability and usability criteria and 1/100, 1/50 and 1/20 scales were used. In the interior design departments, which are the sample group, direct statements regarding the output for the 3rd, 4th and 5th studio levels were not encountered. Only in the 5th studio, there was the expression " final presentation of furniture". Regarding the output of the 6th level graduation projects, it was often seen that the project was a thesis project, and it was stated that a presentation would be made to a jury of
Table 6. "Output" Recommendations for Design Studio Levels.

	Studio Level 1	Studio Level 2	Studio Level 3	Studio Level 4	Studio Level 5	Graduation Thesis / Final Studio (Studio Level 6)
Output	-modelling -scale in 100, 50 and 20 -two and three- dimensional drawings	-modelling -productability and usability -scale in 100, 50 and 20 -two and three dimensional drawings	-direct link for thesis on the project	-direct link for thesis on the project	-final presentation of furniture	-a thesis project exhibition -presenting to a jury of professionals -a thesis

professionals. Table 6 below shows the sub-themes revealed under the "output" meta-theme.

The study findings seen in Table 6 constitute the project course content recommendations for each level. The content analysis method for creating categories was applied based on converting similar sub-themes of the project course data, which were classified in this study, into a code. With this method and approach, the codes shown in the table above contain systematic and objective information that can be used as suggestions for each main theme and each studio level.

6. Discussion and conclusion

In this study, it is aimed to reach subthemes that will reflect international interior design education with the method of content analysis for interior design studios, which is the most comprehensive course group in terms of course duration and professional practices in interior design departments. The findings resulting from this goal are tabulated for creating the studio recommendations, and sub-themes are revealed under the categories (content, skills, subject, output) created for interior design studios. These meta-themes and subthemes have been shown separately for each studio level, and have been made available as a qualified example in the course program studies. Also, to discuss the differences and similarities between the examined schools and the schools in Turkey, no scientific study has been found that deals with the contents of the studios in detail. For this reason, some evaluations based on observations were made in this section.

According to the findings of this study, under the "content" category for the first level studio; It has been observed that there are contents of "human-space relation", "basic design applications", "concept development", "environmental relations and space perception". It is known that this aspect of the content of the first-level studio has long been applied in the interior design schools in Turkey, so it can be considered to be a significant similarity to the first level studio content. Frequently encountered under the category of "skill"; "determining user needs", "determining written program and concept", "high-quality presentation", "ergonomics knowledge" are seen as the basic skills acquired in the first level studio. Under the category of "theme", just as in the preferred section in Turkey, "housing" and "small space" issues came to the fore. Under the category of "output", the studio in the expected results of the project's stages, 2D and 3D drawings and using the technique of model, the data being supplied with match results as related to education in Turkey. In the first level studio in Turkey, it is frequently used in 1/20 scale in drawings and models. It can be said that there is a difference in this regard.

For the second-level studio, although there are concepts that are just beginning to spread last years, "design thinking methods" and "workshops" were faced with the content frequently. Under the category of "skill", the ability to understand market trends stands out as a new and not frequently encountered acquisition at the Turkey scale. There was an intense variety for the second level in the 'subject' category. Especially the "commercial space" and "hospital" that seen as the large-scale issues were found considerable.

The knowledge of working on "innovation processes and technology" in the "content" category for a 3rd level interior

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design studio was considered new and rare. Regarding skills, the category with the most intensive content is the 3rd level studio. "Electrical and mechanical applications", "use of survey technique for research", and "advanced design thinking methods" are among the gains that are very significant and applicable in interior design studios. "Service systems" stands out as an alternative project topic proposal that can be studied at a different level of studio. In the "Output" category, it has been learned that this level can be carried out directly in connection with the graduation (thesis) project in 3-year programs.

4th and 5th level studios can be evaluated together as they are only in 4-year programs and are intermediate studios. Featured contents; conducting design studios in cooperation with other disciplines such as industrial product design and using "innovative design thinking" stands out. In addition, "scenario-based project making" that can be included in both content and skill categories can be considered as an alternative content that can be used in interior design education. It is seen that the practices of "acoustic comfort" and "code and structure regulation" stand out as skills at this level, unlike other levels. At these studio levels, "service design" as a subject has been considered as a new field than other subjects.

Final design studios are often called "thesis" in the analysis of the sample schools. Content of the design studios at this level as "professional simulation" that is, the student is expected to perform at a professional level. At this level, the content and subject are determined by the student in many programs. Independent project management skills are noteworthy in this category. Also, it has been observed that the project subjects are generally complex or multi-functional interiors and a furniture-based project can be in one of the programs examined. In the "output" category, it is frequently encountered in sub-themes that the final product of this level should be a thesis, it is seen that the project is expected to be presented to a jury of professionals and an exhibition is expected. It is known that, arranging exhibitions as output types are often applied in interior design programs.

Another significant conclusion that was reached in the study, when the studio content codes were examined, it was seen that the findings of this study have many common points with the concepts and themes in Table 1 created from CIDA and ECIA reports. Especially when both sources are examined it is precisely seen that, under the meta-themes of "content", "skill" and "output", themes such as "professional practice", "professional business simulation", "project management" that a graduate interior designer should have, and technical competencies for practice were emphasized. Apart from this, it has been observed that concepts such as "design process management", "creative process", "design process" and "problem-solving", which are frequently encountered in the content and skills that studios acquire, are compatible with the competencies under the heading of creative and social skills in Table 1. In addition, the fact that concepts such as "design thinking" and "innovation", which have become widespread in recent years and can be considered more recently, are frequently mentioned in the design studio contents, emphasizes the up-to-dateness of the course contents in this study.

As a result of the analysis of documents obtained within the scope of the study, a comprehensive and up-to-date source was produced that may help instructors and interior design education. Thus, a current and scientifically handled resource has emerged that can be used in the development of the content of project-based studios, which is the most intensive course group in interior design departments. In addition, the study allows seeing which design problems have been discussed in recent years in the world.

Design is a field that constantly renews itself and focuses on different and new problems every year. Therefore, one of the main aims of design education should be to transfer the skills of finding solutions to these new and different problems to design students. In Turkey in terms of the absence of an accreditation body capable of checking the interior design quality of education, this study could contribute data for the process of accreditation studies in interior design. In addition, since this study was structured within the framework of the professional competence principles of CIDA and ECIA organizations in the field of accreditation, the sample group data were selected only from interior design departments in the USA and Europe. Schools from Asia, Middle East or the other regions may be included for future work, including countries that have internationally recognized organizations particularly in the field of design. Thus, the scope of the study can be expanded by increasing cultural and regional differences.

Endnotes

¹ ECIA European Charter of Interior Architecture Training 2020. (https:// ecia.net/media/556/ECIA%20Charter%202020.pdf)

² ECIA European Charter of Interior Architecture Training 2013. (https:// ecia.net/education/charter)

³ CIDA 2020 Professional Standards. (https://www.accredit-id.org/professional-standards)

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Differences in self-regulated learning strategies among industrial design students: A convergent mixed-methods study

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Abstract

The value of self-regulated learning skills for academic achievement has been shown in different domains. However, self-regulated learning skills in design studio education have rarely been studied directly. This study aimed to explore differences in self-regulated learning strategies and motivational factors between high and low achieving industrial design students in an industrial design studio course. We applied a convergent mixed methods design with self-report questionnaires and interviews to gain a comprehensive understanding of students' strategy use. The integrated analysis of quantitative data from 47 students and qualitative data from 16 students demonstrated differences between high and low achieving design students' self-regulated learning skills concerning the use of metacognitive, motivational and behavioral strategies. Together with the expanded integration of data analysis, these findings indicate that self-regulated learning examinations should be undertaken with caution in design studio contexts.

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Design pedagogy, Individual difference, Industrial design, Self-regulated learning, Studio education.

1. Introduction

The perpetual changes in the world require individuals with deep knowledge and skills to navigate the economy and society. Twenty-first-century competencies defined by organizations such as the Organisation for Economic Co-operation and Development (OECD), World Economic Forum and the United Nations Educational, Scientific and Cultural Organization (UNESCO) concur regarding the need for agency, awareness and ability of learners to deal with complex problems (see Rieckmann, 2018; Schleicher, 2018; World Economic Forum, 2020). Providing learners with these skills is important at all education levels. Industrial design (ID) studios in universities can facilitate these abilities as they provide students with essential skills and experiences to cope with complex real-world problems that are accepted as key characteristics of design practice. Along with the changing target competencies, self-regulated learning (SRL) - representing metacognitive, motivational and behavioral strategies - has attracted much attention in the last four decades due to its contribution to academic skills (Zimmerman, 1989b, 2008). These academic skills promote future competencies related to learning strategies. While some studies indicate that studio education fosters SRL skills (e.g., Greene et al., 2019), SRL strategies in ID studios and individual differences in SRL among design students remain under-studied. This research explores the differences in SRL strategies between high and low achieving students in an ID studio course. The study aims to understand the differences between ID studio students and define the dynamics of SRL in the design studio to improve design studio education.

1.1. Self-regulated learning

The social cognitive theory defines self-regulation as interaction within personal, behavioral and environmental factors (Bandura, 1986; Zimmerman, 1989a, 2000). In learning environments, the changes in these factors necessitate the regulation of the learner (Zimmerman, 1989a; Zimmerman & Cleary, 2009). Self-regulated learners can define personal goals; choose, develop and perform appropriate strategies; monitor their process and regulate according to outcomes with a belief of self-efficacy (Nilson, 2013; Zimmerman & Schunk, 2011). There is vast evidence that SRL strategies help students accomplish their academic goals (Sungur & Yerdelen, 2011; see also Zimmerman, 2000; Zimmerman & Schunk, 2011). However, even in tertiary education, most students do not know how to learn (Nilson, 2013). Students at this level may have difficulties making strategic choices that prevent them from achieving, especially in their professional lives (Sakız, 2014). Thus, the goal of higher education should involve providing academic and professional knowledge and teaching effective learning strategies to create life-long learners (Tas & Sungur, 2012; Zimmerman, 2002).

Multiple SRL models have been proposed based on theoretical perspectives. A common feature of these models is that students use different activities, skills or strategies to control and regulate their learning (Jansen et al., 2019; Dale H. Schunk & Zimmerman, 1994; Zimmerman & Schunk, 2011). Zimmerman's SRL perspective (see Zimmerman, 1989a, 1990) which has been used more frequently because of its specific subprocesses (Panadero, 2017) defines self-regulated learners as individuals who actively engage in and manage their learning through metacognitive, motivational and behavioral activities (Zimmerman, 1989b, 2002, 2008). In terms of metacognitive processes, self-regulated students plan their learning process, determine goals, monitor, evaluate and reflect on their cognitive strategies (Dinsmore et al., 2008; Veenman, 2017). They have a high level of self-efficacy, i.e., belief in the ability to complete a task successfully. As motivational processes, they are intrinsically interested in tasks and responsible for their achievement outcomes (Zimmerman, 2008). For behavioral processes, they seek information and help, and structure learning environments (Sebesta & Speth, 2017; Zimmerman & Martinez-Pons, 1986, 1990). This study refers to these three strategy categories of Zimmerman's model to explore the SRL dynamics in design studio (see Table 1).

SRL skills are teachable (Panadero & Alonso-Tapia, 2014). However, as some students already have these skills (Nilson, 2013), defining and assessing the level of existing strategy use is an important first step. Self-report (i.e., questionnaires, interviews, think-aloud and learning diaries) has become the most common method for identifying and evaluating SRL strategies (see Azevedo et al., 2009; Kavousi et al., 2019; Kryshko et al., 2020; Loeffler et al., 2019; Räisänen et al., 2016). Although these measures do not track real-time performance and are prone to recall distortions (Veenman, 2017), they play a crucial role in reporting psychological processes in SRL (Pekrun, 2020). However, using one single tool has been criticized because of its inherent weakness in capturing the learning strategies (Perry, 2002). Clearly et al. (2012) highlight multifaceted evaluation as the most useful method for increasing self-regulation strategies knowledge (e.g., Baldan Babayigit & Guven, 2020; Coertjens et al., 2016; Foerst et al., 2017; Hendriks et al., 2020; Jansen et al., 2020; Pekrun et al., 2002; van Laer & Elen, 2020). Mixed methods approach offers advantages for SRL studies in compensating for missing data and confirming overlapping data (see Plano Clark, 2019). This study aimed to identify design students' SRL strategy use, taking advantage of both questionnaires and interviews as mixed methods. The first author also observed students for an entire semester - in the studio coordination team participating in all classes and this was hypothesized to provide more reliable estimates of strategy use.

To better understand the complex relationship between SRL strategies and academic achievement, students' strategy use must be compared relative to their achievement levels. Research has compared high and low achievers' attitudes and characteristics, attended various education and learning environments (e.g., Coertjens et al., 2016; DiFrancesca et al., 2016; Erdogan, 2011; Fadlelmula et al., 2015; García-Pérez et al., 2020; Geduld, 2016; Khan et al., 2020; T.-H. Lee et al., 2010; Nandagopal & Ericsson, 2012; Sungur & Yerdelen, 2011). Very few empirical

studies have focused on SRL in design studios (e.g., Oluwatayo et al., 2015; Powers & Miller, 2008). Despite different domains and tools, the general results of these studies were similar, i.e., SRL positively affects academic achievement. However, few descriptive studies demonstrated that SRL strategies are nuanced, depending on the specific event (Nandagopal & Ericsson, 2012). Greene et al. (2015) found that advanced cognitive strategies varied according to discipline. The detection of these domain-specific differences remains a gap in the literature (Alexander et al., 2011; Greene et al., 2015). Thus, this study used qualitative interviewing methods to explore students' perspectives regarding domain-specific learning strategies, attempting to align with the quantitative approach to develop a primary perspective on individual differences, especially for low achieving design students.

1.2. Industrial design studio education and self-regulated learning

University students need to be independent learners with the capacity to plan, monitor and evaluate their work and control motivation and emotion (Vosniadou, 2020). Some professions demand these skills in different approaches, which creates characteristic forms of teaching and learning. Shulman (2005) defines these unique preparations for the professions as 'signature pedagogies.' Design studio education is a signature pedagogy with a distinct pedagogical method (Shreeve, 2015; Shulman, 2005) that includes learner-centeredness, interaction between the actors and the studio environment (Yorgancioglu, 2020).

Industrial design undergraduate education occurs over eight semesters and at least four years. Studio teaching occupies about 30% of the entire curriculum. In design studio, starting with a project brief involving 'ill-defined' (Rittel & Webber, 1973) or 'wicked' (Simon, 1973) problems, students are expected to develop solutions and present them showing weekly progress to discuss with the instructor or peers and guests (Goldschmidt et al., 2010), known as studio critics. Critics

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iteratively provide students with a constructive learning process (Tovey, 2015). Conversation between student and instructor centers around the student's work (Schön, 1987). Thus, students are the main actors and fully responsible for constructing self-knowledge. However, this critical and self-constructive process may create challenges for students who struggle to engage with the socio-cultural context. They may not meet the studio expectations and lose their self-confidence (Masatlıoğlu & Takkeci, 2016). They need a 'safe space' to realize and develop their design approach without the fear of failure (Bull, 2015). Studio instructors should encourage skills (e.g., critical thinking, self-reflection, self-regulated learning, perseverance) necessary to address the fluidity of design problems (Smith, 2005).

Learner-centered learning traits can be observed in most forms of design studio education (i.e., architectural, interior, landscape and industrial design). Such approaches include problem-based learning (Boyer & Mitgang, 1996; Galford et al., 2015; Smith, 2010), project-based learning (Bell, 2010; Kuhn, 2001), the alternative student-centered framework described by Lee and Hannafin (2016) in response to criticisms of other studio-oriented/based learning (Cennamo et al., 2011; Kjesrud, 2021; Zairul, 2018). These learning-based studies highlight the essential characteristics of the studio pedagogy, which are about experiencing and understanding the design process (Smith, 2010). Studio education is widely held to place the student in the center with active participation (Powers, 2016), but learner-centered learning tends to be disregarded in studio instruction (Zairul, 2020). In their review study, de la Harpe and Peterson (2009) revealed a greater emphasis on teaching techniques rather than learning techniques in studies of design studios. Therefore, improved scaffolding is needed, considering the learning process of design students.

Design entails a highly organized mental process that manipulates and blends several forms of information into ideas to produce outputs (Lawson, 2005). Cognitive strategies of expert designers' idea-generation process provide some instructional information for studio education (Christiaans, 2002; Cross, 2001; Hasirci & Demirkan, 2007; Haupt, 2015; Kim & Kim, 2015; Newstetter et al., 2001; Oxman, 2001). However, how designers choose and organize these strategies is a metacognitive process that has been unobserved in design cognition (Ball & Christensen, 2019). Based on the limited number of studies (e.g., Ball & Christensen, 2019; Carlson et al., 2020; Hargrove, 2007; Kavousi et al., 2020; Kurt & Kurt, 2017; Tobón et al., 2021) design metacognition appears critical to every aspect of design activity. Nevertheless, design learning is a different process to designing and should be studied with educational theories of learning serving as a foundation for design education (Oxman, 1999). Metacognitive knowledge - as an aspect of SRL - would help novice designers to have a more holistic perspective of learning process, yet important questions about design metacognition remain to be answered.

Studio instructors' pedagogical approach influences student's skill development and self-perception as designers (Yorgancioglu & Tunalı, 2020), and this promotes self-reflection and self-regulation (Greene et al., 2019). However, students' learning approach needs to be aligned with the SRL potential of studio pedagogy. To address this issue, Powers (2016) proposed a methodology within a landscape design studio that incorporates SRL and the process of design learning. In this model, students are actively involved in their learning through SRL, and instructors develop individual objectives for each student. In another study of architecture studio, Zairul (2018) advances a model based on self-regulated theory, which focuses on peer review during studio hours and individual critique beyond studio hours. Despite practical challenges for studio instructors, these studies contain valuable insights for ID studios.

1.3. Current study

Studio education has used a student-centered lens since Schön's (Schön, 1984) concept of the 'reflective practitioner' was incorporated (Iftikhar et al., 2018). To maintain student-centeredness, learner characteristics should also be considered and monitored for personal and social transformation (Thompson, 2020). This creates space for students to acknowledge their agency in shaping their learning process. Hence, we question the claims of the learner-centered and constructivist approach to studio education, shifting the focus to learner autonomy and self-regulation.

While numerous studies have focused on improving specific SRL components, few have examined the differentiation of SRL variables between high and low achieving students in a design studio context. This exploratory study aimed to describe and compare ID students with high and low achievement levels concerning metacognitive, behavioral and motivational SRL factors using both quantitative and qualitative data. This approach may help to understand different learning styles and delineate areas of self-regulation that could be strengthened to support struggling students. Based on these aims, four research questions were formulated:

1. Are there meaningful differences between the SRL skills and motivation of ID students with different academic achievement levels?

2. What are the SRL skills frequently used by ID students with different academic achievement levels?

3. How do high and low achieving ID students perceive their own studio course experiences?

4. To what extent do qualitative and quantitative results converge?

2. Materials and methods

2.1. Participants and procedure

We conducted this study in the Industrial Design Department at a private university. Quantitative data were collected from 47 third-year undergraduate design students (33 females, 14 males). They were on average 21.2 years old (SD = 0.98) and all were in their fifth semester. Qualitative data were collected in a third-year design studio course comprising 16 students (10 females, 6 males) wanting to participate in the study voluntarily. All documents and conversations were in students' native language. The data were stored and transferred using multidigit codes to ensure anonymity. Participants were provided with written information, assured of confidentiality and gave their informed consent to participate. The questionnaire and interviews were administered at the end of the semester so that students could reflect on their current studio projects.

This study focused on third-year design students as, at this level, they have completed at least four semesters of the curriculum, including four design studio courses. Additionally, in the third year, the focus of the studio content moves from a general introductory level controlled by the instructors to an individual development level managed by the students themselves (Uluoğlu, 2000). This more individualized studio context helps students experience more self-process time and allowed us to observe the students in their approach to design.

2.2. Materials

In this study, we followed a convergent mixed-methods procedure (see Creswell & Plano Clark, 2018) undertaking quantitative and qualitative investigation concurrently. We integrated the results through merging analysis and interpreted them to gain a realistic and holistic understanding of students' strategy use.

2.2.1. Quantitative measure: Scale on Self-Regulation in Learning (SSRL)

The self-report questionnaire, 'Scale on Self-Regulation in Learning (SSRL),' was used to determine the relationship between self-regulation and academic achievement of design students. SSRL is a validated self-report scale developed by Erdogan (2012; for the English version see Erdogan & Senemoglu, 2016) to evaluate the SRL skills of [anonymized] university students focusing on their learning habits. The scale consists of two sub-scales: The SRL skills section covers 12 dimensions developed based on Zimmerman and Pons's (see 1986) Self-Regulated Learning Interview Schedule (SRLIS) (Erdogan & Senemoglu, 2016) and the motivational section covers five dimensions (Table 1). The scale has 17 dimensions with 67 items in total and is scored on a fivepoint Likert scale ranging from 'Never' to 'Always'. According to Erdogan

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(2012), the reliability coefficient was calculated as Cronbach Alpha 0.91 for the entire scale showing high internal consistency.

The structure of studio education is different from regular classes. Thus, terms related to class courses in the scale had to be slightly adapted for studio conditions and terminology to enable the students to understand and respond regarding their studio process (e.g., the word 'studio coordinator' was used instead of 'teacher,' and 'jury presentation' instead of 'exam').

The SSRL scale was conducted with hard copy documents, and students were asked to think of how they studied in that studio course. The first author facilitated the questionnaire process with the students and responded to any questions asked.

2.2.2. Qualitative measure: Semistructured interviews

Theory that distinguishes between SRL and ID education is important as SRL and motivation have not been studied structurally for design studio education, the backbone of ID bachelor programs. Qualitative research is an effective tool to understand the relationship between student attributes and the learning environment (Araz & Sungur, 2007) and between SRL and motivation in a design learning context (Powers, 2006). Semi-structured interviews were designed for students to talk deeply about their learning experience in general and in the studio course they had recently completed. The interview questions were developed considering the interview approaches used in other SRL studies (see Coertjens et al., 2016; Kitsantas, 2002; Ley & Young, 1998; Nandagopal & Ericsson, 2012; Powers & Miller, 2008; Sundre & Kitsantas, 2004; Zimmerman & Martinez-Pons, 1986) and rephrased using design terminology. Without asking directly about SRL, it was possible to see how important self-regulation was in their process (Räisänen et al., 2016). Based on the qualitative analysis approach of this study, interviews and their analysis proceeded simultaneously and iteratively. Follow up questions to probe further were formulated as the analy*Table 1.* Sub-scales and factors of the Scale on Self-Regulation in Learning (SSRL) and strategy types used in this study.

Scale on Self-Regulation in Learning (SSRL) (Erdogan, 2006)	N	Type of strategies used in this study
Self-Regulated Learning Skills		
Arrangement of study time	4	Metacognitive strategies
Planning	5	Metacognitive strategies
Environmental structuring	4	Behavioral strategies
Organizing and transforming	5	Cognitive/Metacognitive strategies
Seeking appropriate information	3	Metacognitive strategies
Seeking easily accessible information	2	Metacognitive strategies
Rehearsing and memorizing	4	Cognitive/Metacognitive strategies
Self-monitoring	2	Behavioral strategies
Seeking peer, teacher or adult assistance	3	Behavioral strategies
Self-evaluation	6	Metacognitive strategies
Self-consequences after success	4	Metacognitive strategies
Self-consequences after failure	3	Metacognitive strategies
Motivational factors		
Self-efficacy	5	Motivational strategies
Goal orientations	3	Motivational strategies
Task value	5	Motivational strategies
Attributions for failure	4	Motivational strategies
Anxiety	5	Motivational strategies

sis was undertaken and following interview sessions were organized with the 16 interviewees.

Sixteen third-year ID students were interviewed at the end of the term. Conducted by the first author, the interviews were recorded using a digital voice recorder and lasted 40 to 60 minutes depending on follow-up questions and probes. A total of 645 minutes was recorded, saved and transcribed verbatim. Semi-structured interviews required a questionnaire form to guide the flow of the conversation and remain on topic.

2.3. Data analysis

This study used a convergent mixed method with qualitative and quantitative data collection occurring concurrently and then integrated for analysis.

2.3.1. Grouping procedure

For quantitative analysis, the sample (N=47) was divided into high and low achieving groups to investigate the SRL skills of students with different achievement levels. The division into groups took place according to the students' average of the last two official studio grades, which were accepted as indicators of consistent achievement (see Boud & Falchikov, 2006; as cited in García-Pérez et al., 2020; Soderstrom & Bjork, 2015). Twenty-three students with grades above 77 (M=81.7, SD=4.06) were assigned to the high achieving group, and 24 students with

grades below 77 (M=65.8, SD= 8.51) were assigned to the low achieving group. Mann-Whitney U test showed the total scale scores for these two groups to be significantly different with mean rank for high achievers = 13.85, and mean rank for low achievers = 34.59 (U=32.5, z= -5.186, p < .001).

For qualitative analysis, 16 interview participants were again divided into two achievement groups. Six students with grades above 77 (M=83.6, SD=2.96) were assigned to the high achieving group, and 10 students with grades below 77 (M=66.6, SD=6.08) were assigned to the low achieving group. Mann-Whitney U test showed the total scale scores for these two groups to be significantly different again.

2.3.2. Quantitative analyses

In this study, Cronbach's alpha coefficient was calculated as 0.84 for the whole scale, 0.81 for Self-regulated Learning Skills and 0.67 for Motivation.

Descriptive statistics were used to describe the sample population. The normal distribution of the data was examined and confirmed: the Shapiro-Wilk test concluded that the significance value was higher than .05 in all sub-scales; Kurtosis and Skewness values were within the ± 1 range for all variables, and the histogram chart showed the data had a normal distribution. However, as the sample size for each group was less than 30 participants, it was decided to use non-parametric tests. The Mann-Whitney U test was performed to determine which achievement level caused significant differences between scale mean scores.

2.3.3. Qualitative analyses

In this study, the first author, as a research assistant, had an active involvement in the design of the studio process from which the data were collected. Both the qualitative data collection and analysis process was based on constructivist grounded theory (CGT) because of the first author's active stance, relatively small sample and data construction with mutual interaction between the researcher and the research itself (see Arik & Arik, 2016; Charmaz, 2006; Strauss & Corbin, 1994, p. 273, 1990, p. 24)

The analysis of the interviews was conducted in two phases. In the first phase, we aimed to elucidate the elements of the studio processes and students' understanding by analyzing the data gathered from the interviews without theoretical assumptions. To follow up the procedure of CGT, data collection and analysis proceeded simultaneously and iteratively. The audio recordings were transcribed and transferred into the MAXQDA'18 Qualitative Data Analysis Program, which provided us with the tools to organize and analyze the data. As Charmaz (2021), the first step of coding, termed 'initial coding,' was carried out line-byline using the interviewees' words (in vivo) whenever possible to preserve the sense of action. In vivo coding enabled us to see similar actions of the students with different statements and ask more focused follow-up questions during the interviews. The second step of coding proceeded with focused coding, which consisted of reviewing and synthesizing the initial codes and identifying relationships among them to create categories. In this phase, the transcriptions were grouped into the two achievement levels and the initial codes were reviewed within the groups to transform them into more abstract categories. Categories were reread and regrouped in relation to each other to develop patterns and create core categories.

In the second phase of the analysis, we aimed to identify the differences between high and low performers and the factors related to individual differences in SRL approach and motivation, with a more theory-driven approach. The descriptions in the categories were conceptualized and coded according to the SRL dimensions of Zimmerman's theory (2000; see Zimmerman & Moylan, 2009).

The first phase of the analysis was carried out by the first author, and the second phase was discussed in depth together with the second author.

2.3.4. Data integration

As this study followed a convergent mixed methods design, quantitative and qualitative findings were integrated under the guidance of the fifth research question. As suggested by Creswell and Plano Clark (2018) and O'Cathain (2010), a comparison matrix (Table 2) was used to assess both data sets and determine the levels of agreement. There is agreement when the qualitative findings are explanatory, and 'dissonance' when findings are inconsistent. Such intra-method discrepancies can be harnessed to examine each data set more sufficiently (Moffatt et al., 2006). Thus, we used dissonances to identify potential explanations from theory (as cited in Fetters et al., 2013; Pluye et al., 2005). The coherence of the results is an important aspect of integration. Fetters (2013) identifies that the degree of integration, termed 'fit,' may either be confirmation, expansion or discordance. As the findings from the two sources diverge and expand the insights, the level of integration was considered as expansion in this study.

3. Results

The quantitative and qualitative analyses associated with each of the four research questions are presented in turn.

3.1. Results for quantitative analysis

The research question Are there meaningful differences between the SRL skills and motivation of ID students with different academic achievement levels? was studied using quantitative data. Descriptive statistics (Table 3) were used to describe the sample population. Means of SRL total and Motivation were calculated as 3.30±0.34, and 3.16±0.39, respectively. Within SRL factors, self-evaluation was the most frequently used, while seeking easily accessible information was the least used strategy. Within motivation factors, task value had the highest use whereas anxiety obtained the lowest scores.

Table 4 shows the differences between the SSRL mean scores of students, which were 235.3 (SS= 15.48) for high achievers and 205.1 (SS=16.41) for low achievers. To determine if differences are significant in scale scores between groups, the Mann-Whitney U test was run. Total scale scores were found to be significantly higher for high achievers (mean rank=13.85, U=32.5, z= -5.186, p< .001) than for low achievers (mean rank=34.59, U=32.5, z= -5.186, p< .001), as were the scores of subscales (i.e., SRL Total and Motivation). Table 2. Comparison of quantitative and qualitative findings.

SRL strategies & Motivational factors	Quantitative	Qualitative	Agreement, partial agreement, dissonance, expansion, no match
Planning	++	+	Partial agreement
Environmental structuring	-		No match
Organizing and transforming	++	++	Agreement
Seeking appropriate information	-	+	Dissonance/Expansion
Seeking easily accessible information	-	+	Dissonance/Expansion
Rehearsing and memorizing	-		No match
Self-monitoring	-		No match
Seeking peer, teacher or adult assistance	-	+	Dissonance/Expansion
Self-evaluation	++	++	Agreement
Self-consequences after success	-		No match
Self-consequences after failure	++	++	Agreement
Self-efficacy	-	+	Dissonance/Expansion
Goal orientations	-	+	Dissonance/Expansion
Task value	++	+	Partial agreement
Attributions for failure	++	++	Agreement
Anxiety	-		No match

+: supporting/related information related to a finding

-: contrasting information related to a finding No symbol: no information

Table 3. Descriptive statistics of scale results of students.

SRL Skills	Ν	Number of items	Mean	Std. Deviation	Minimum	Maximum
Arrangement of study time	47	4	2,98	0,59	1,75	4,00
Planning	47	5	3,09	0,58	1,80	4,40
Environmental structuring	47	4	3,78	0,87	1,00	5,00
Organizing and transforming	47	5	3,50	0,76	2,20	5,00
Seeking appropriate information	47	3	3,12	0,74	2,00	4,67
Seeking easily accessible information	47	2	2,30	0,95	1,00	4,50
Rehearsing and memorizing	47	4	3,15	0,58	2,00	4,50
Self-monitoring	47	2	3,55	0,96	1,00	5,00
Seeking peer, teacher or adult assistance	47	3	3,60	0,79	1,67	5,00
Self-evaluation	47	6	3,84	0,73	1,83	5,00
Self-consequences after success	47	4	2,94	1,20	1,00	5,00
Self-consequences after failure	47	3	3,45	1,00	1,00	5,00
SRL Total	47	45	3,30	0,34	2,33	3,92
Self-efficacy	47	5	3,63	0,65	2,00	4,60
Goal orientations	47	3	3,18	0,93	1,33	5,00
Task value	47	5	4,03	0,87	1,00	5,00
Attributions for failure	47	4	2,56	0,81	1,00	4,50
Anxiety	47	5	2,42	0,73	1,00	4,00
Motivation	47	22	3,16	0,39	2,41	4,04
SSRL TOTAL	47	67	3,24	0,31	2,44	3,90

Table 4.	Group	statisti	ics and N	/ann-	Whitney	U test	results	of scale
and subs	scale sco	ores of	students	with	different	achiev	rement	levels.

Dimensions	Achievement Level	N	Mean	Std. Deviat ion	Std. Error Mean	Mann- Whitney U	Wilcoxon W	z	Asymp. Sig. (2- tailed)
CODI TOTAL	High achieving	23	235,3	15,48	3,23	32,500	332,500	-5,186	0,000*
SSRL TOTAL	Low achieving	24	205,3	16,41	3,35				
CDI Total	High achieving	23	159,87	11,226	2,341	62,500	362,500	-4,548	0,000*
SKL TOLAT	Low achieving	24	139,67	14,699	3,000				
Mathem	High achieving	23	75,43	6,953	1,450	91,000	391,000	-3,944	0,000*
wouvation	Low achieving	24	65,63	7,534	1,538				
Arrangement of study time	High achieving	23	12,26	2,508	0,523	225,500	525,500	-1,084	0,278
	Low achieving	24	11,58	2,244	0,458				
Discusion	High achieving	23	16,48	2,937	0,612	159,000	459,000	-2,507	0,012*
Planning	Low achieving	24	14,42	2,483	0,507				
Environmental	High achieving	23	15,87	2,719	0,567	219,000	519,000	-1,220	0,222
structuring	Low achieving	24	14,38	3,998	0,816				
Organizing and	High achieving	23	19,65	2,587	0,539	92,500	392,500	-3,938	0,000*
transforming	Low achieving	24	15,38	3,609	0,737				
Seeking appropriate	High achieving	23	9,826	2,3091	0,4815	209,500	509,500	-1,432	0,152
Seeking appropriate information Seeking easily accessible information	Low achieving	24	8,917	2,0834	0,4253				
Seeking easily	High achieving	23	4,74	1,912	0,399	247,500	547,500	-0,616	0,538
Seeking easily accessible information	Low achieving	24	4,46	1,911	0,390				
Rehearsing and memorizing	High achieving	23	12,91	1,952	0,407	214,500	514,500	-1,329	0,184
	Low achieving	24	12,25	2,609	0,532				
	High achieving	23	7,65	1,968	0,410	202,000	502,000	-1,597	0,110
Self-monitoring	Low achieving	24	6,71	1,805	0,369				
Seeking peer, teacher	High achieving	23	11,22	1,704	0,355	230,000	530,000	-0,987	0,323
or adult assistance	Low achieving	24	10,46	2,734	0,558				
Solf evaluation	High achieving	23	25,00	3,162	0,659	122,000	422,000	-3,289	0,001*
Sen-evaluation	Low achieving	24	21,00	4,709	0,961				
Self-consequences	High achieving	23	12,83	3,881	0,809	215,500	515,500	-1,291	0,197
after success	Low achieving	24	10,88	5,245	1,071				
Self-consequences	High achieving	23	11,43	2,826	0,589	151,500	451,500	-2,665	0,008*
after failure	Low achieving	24	9,25	2,848	0,581				
Solf officeou	High achieving	23	19,09	2,875	0,599	204,500	504,500	-1,530	0,126
Sell-enicacy	Low achieving	24	17,42	3,348	0,683				
Cool orientations	High achieving	23	9,91	2,811	0,586	257,500	557,500	-0,397	0,692
Guai Unentations	Low achieving	24	9,42	2,873	0,586				
Teekuelue	High achieving	23	21,65	3,393	0,707	175,500	475,500	-2,151	0,031*
lask value	Low achieving	24	18,79	4,690	0,957				
Attributions for	High achieving	23	11,57	3,160	0,659	146,000	446,000	-2,785	0,005*
failure	Low achieving	24	8,92	2,858	0,583				
	High achieving	23	13,22	3,343	0,697	196,000	496,000	-1,708	0,088
Anxiety	Low achieving	24	11,08	3,670	0,749				

Table 5. The emerging main themes and their sub-categories of the qualitative analysis.

1.0 Student theme: feelings and thoughts of industrial design students

1.1 Comments on their strength and weakness 1.2 Interpretation of success in the studio

2.0 Project theme: expressions of industrial design students

- 2.1 Strategies they applied
- 2.2 Interpretations in the process
- 2.3 Comments on the outcome

3.0 Studio theme: external factors industrial design students are exposed t

- 3.1 Peer interaction
- 3.2 Feedbacks
- 3.3 Managing information

Table 6. Representative quotations in student theme: feelings and thoughts of industrial design students.

Subthemes:	Representative quotations of low	Representative quotations of high
	achiever design students	achiever design students
Comments on	"I'm very bad at making models. I wish	"I thought that presentation was my
their strengths	there were not any obligatory models	strong skill, but when I see the other
and	for projects." (L.5)	works, I realized that it was not as good
weaknesses	"I definitely cannot think in an abstract	as I believed. So, this term, I mostly
	way. I wish [this skill] was taught to	focused on developing my presentation
	me in my first year." (L.12)	skills as well." (H.11)
Interpretations	"I thought my project subject was not	"To be successful in the studio means
of success in	different enough. That is why I got a	keeping the project subject in your mind
the studio	lower grade than others. For example,	every time and everywhere and
	someone seemed successful because	embracing the subject when you did not
	she chose a very different subject and	like it. Pushing yourself to like it. Not
	drew the attention of the instructor."	giving up." (H.14)
	(L.5)	"Success in studio depends on the first
	"I tried to find an uncommon thing that	impression of the instructors. Sincere
	would interest instructors more." (L.3)	interaction is important." (H.16)

To answer the second research question What are the SRL skills frequently used by ID students with different academic achievement levels? the students' overall average score, together with subscales for each SRL skill and motivational factors, were compared. According to Mann-Whitney U test results (Table 4), student achievement levels differed significantly when comparing scores for planning, organizing and transforming, self-evaluation and self-consequences after failure. High achievers were better at planning their studies, rearranging their instructional materials, evaluating their work and consequences after failure. High achievers had significantly higher scores for task value and attribution for failure, which means they appreciated what they learned more than low achievers, and they attributed their failure to controllable factors such as their lack of effort.

3.2. Results for qualitative analysis

Descriptive statistics were used to describe interviews with 16 students, consisting of 6 high achievers (5 females, 1 male) and 10 low achievers (5 females, 5 males). The means of total SSRL scores were 241.3 (SS=14.61) for high achievers and 198.6 (SS=22.67) for low achievers. Another Mann-Whitney U test was run and total SSRL scores were found to be significantly higher for high achiever interviewees (mean rank = 13.50) than for low-achiever interviewees (mean rank=5.50) (U=0, z=-3.259, p< .001). The groups of low and high achievers were the determinants in the interview data analysis enabling to build the descriptive statistics.

To answer the third research question, *How do high and low achieving ID students perceive their own studio course experiences?*, interview data were analyzed using the CGT approach. The emerging main themes and their sub-categories are presented in Table 5. This section includes key findings on student studio experiences with representative quotations in Table 6,7 and 8; and discusses them through SRL strategies.

3.2.1. Analysis of themes

In the qualitative analysis, the data obtained from the interviews were classified under three main themes: student, project and studio. Representative quotations from the students are shown in Tables 6, 7 and 8.

3.2.1.1. Student theme: Feelings and thoughts of industrial design students

This student theme contained students' feelings and thoughts about themselves and their project experience. Through scrutinizing their feelings and definitions, we aimed to understand the differences in awareness due to achievement level in the studio course. Under this theme, we examined (a) comments on their strengths and weaknesses, and (b) interpretations of success in the studio. Table 6 provides representative quotations for this theme.

Students in both achievement groups were aware of their strengths and weakness, showing evidence of good metacognitive skills. However, high achieving students embraced their weaknesses and explained what they had done to strengthen them. In contrast, low achieving students expected to be taught to address their weaknesses. These attitudes indicate that low achievers need more metacognitive regulation, especially in self-evaluation and self-consequences.

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Low achievers believed that finding a different project topic and developing it based on instructors' predispositions was sufficient for studio success. In contrast, high achievers had a sense of ownership in the process through participating and being able to interact with the instructor. Low achievers considered tasks as the opportunity to gain positive comments from instructors, while high achievers mentioned learning-oriented goals such as benefits for their improvement. The difference in goal orientation and task value indicated problems in low achievers' motivational regulation.

3.2.1.2. Project theme: Expressions of industrial design students

This project theme included students' expressions of their behaviors and discourses (e.g., homework, presentation, process experience and learning experience). We focused on analyzing students' descriptions of what they did during their project. In this theme, (a) strategies, (b) interpretations and (c) comments on the outcome were examined. Table 7 provides representative quotations.

The students' descriptions indicated that they found it hard to decide between realistic or conceptual projects, stated as developing either a functional product or a meaningful one. Low achieving students complained about their difficulties with a meaning-focused approach and even attributed their low grades to this. This indicates evidence of deficiency for developing appropriate strategy. By contrast, high achievers approached their designs in a more integrated way. The challenge in deciding on specific task strategies indicates problems related to understanding the project holistically and using self-instruction.

The students demonstrated effective self-evaluation skills when they described their studies in the studio. They criticized their own behavior and work. They were highly aware of what they had been doing. However, when describing specifically their study for tasks, it was clear that high achievers developed their projects by interpreting the tasks, feedback, and experiences from other courses. This is evidence

Table 7. Representative quotations in project theme: expressions of industrial design students.

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Subthemes:	Representative quotations of low achiever design students	Representative quotations of high achiever design students
Strategies they applied	"I could not understand which part I should focus on product or meaning. Finally, I could not find any meaning for my product, and failed." (L.5)	"I thought about approaching my project in a functional way (product oriented) or meaningful way. Then found a way to synthesize the story (meaning) and the product (function)." (H.11)
Interpretations in the process	"In my critic session, the idea of an island bathroom came up – indeed, it was not my idea. After that, I lost control and got off the subject. I could not explain what I am doing and why I am doing this. Later.co., I saw others' projects they were working on, such as flowers, pots, etc. I started to ask myself. Could I have these kinds of extreme (crazy) ideas, too? I wanted to design a product, but on the other hand, everyone was flying (a common saying for having extreme or crazy ideas), and I wanted to fly too, which I could not." (L.5)	"I think I'm good at the studio. I study, I make a great effort. I believed that I analyze the feedback very well, so I know my mistakes. I write down almost everything. That's the point that makes me strong. When an instructor says something to me which I do not agree with, I fix it (interpret it) in my own way. I always compare my work by watching the others' work, and so I can understand whether I'm
Comments on the outcome	"I liked my first idea, but not the process. I felt like I got stuck and could not find anything I wish I did something different than that (the project). I think I started in the wrong way I mean, if I did my research better, I could do a better project. Hopefully, I can learn how to do that maybe in my first job." (L.20)	"I cannot say it is over. Projects need to get a final presentation once the term finishes, but I think they never end. I liked working on it, after all. There are still things to develop, and I'm planning to develop my project to put in my portfolio." (H.10)

of high achievers' integrative approach. In contrast, low achieving students submitted the tasks with minimal effort without interpretation, were highly influenced by examples and likes, fixated on given ideas and lost their motivation in the face of harsh criticism. The low interpretation attitude revealed problems with cognitive and metacognitive regulation.

The students also commented on the outcomes differently. High achievers wanted to improve the whole process by deducing from their experiences and believed that a project never ends. They had short-term action plans with long-term goals. Low achievers were oriented further in the future. They did not enjoy the process, wanted to change it entirely and believed that they would learn eventually in their professional lives. Self-commenting on outcome defensively or offensively affected motivation and goals directly.

3.2.1.3. Studio theme: External factors to which industrial design students are exposed

The third category was about the external factors to which students are exposed (e.g., studio subject and description (project brief), studio space, instructors and peers). Students were encouraged to talk about external factors to the studio such as the brief, studio environment, instructors, peers and other factors affecting their project process. Under this theme, (a) peer interaction, (b) feedback and (c)

Subthemes:	Representative quotations of low achiever design students	Representative quotations of high achiever design students
Peer interaction	"It is very hard for me to adapt here (in the studio). I prefer to study at home, alone. The studio is more like meeting friends, chatting, eating. When I try to study in the studio, I need to get up every 15 minutes, walk around, and I see others' works so I cannot focus on my ideas." (L.17) "When I saw someone's project presentation in the midterm jury, I felt discouraged. The subject she was working on was not so fancy, but the process she performed was highly developed. After that, I decided not to look at her work at all before submitting my work, I checked the other work submitted in the folder (online submission platform). If they are as	"I like to study in the studio. I do not feel sleepy since everyone works, and it makes me feel more motivated." (H.11) "We (peers) always talk about our projects, even during our breaks in the studio. When I see or think something about my friends' projects, I tell them and we discuss it together, for example, while drinking our coffee in the break." (H.14)
Feedback	"In the critic sessions or juries, I feel demoralized because of the way we are criticized. I know that I should not get offended personally, but I did. I feel degraded. I don't even care about the grade at that moment. The critiques should have been given more gently and kindly." (L.3) "Since my project went badly, even when I came eye to eye with the instructor in the studio, I felt stressed. While having my critique, my hand was shaking. Sometimes I got the impression from the teachers that they wanted to get out of my session. I thought they did not want to listen to me at all." (L.17)	"In a critic session, my idea was criticized heavily. That session was my turning point. I started to think more seriously." (H.1) "Soft critics make me happy, but I cannot keep it in my mind. But heavy criticism stays in the mind for weeks, affecting me so much more positively." (H.14) "Sometimes I ask other instructors in the department since they can offer more realistic critique as an outsider." (H.10)
Managing information	"First, I searched on the internet for designs of this kind of object. I saw some rope and shelters. I like these kinds of materials, so I thought there could be small modules like this after a while, I saw that the thing in my mind was already designed, and I was very sorry. I searched the designer's work deeply, and I changed my project according to myself." (L.7) "I searched on the internet about the keywords in the brief, but it was not helpful for me. I wanted to see what kind of concepts I'm interested in finally, I decided on something when I saw some projects on sports areas I'm familier with "(L. 20)	"Mostly I search on the internet for my presentations. I think it is also important. I want to trust my visual presentation to talk about my ideas confidently." (H.11) "I did my research to understand the problems in public toilets. I mostly read forums or some documents about it." (H.10)

Table 8. Representative quotations in studio theme: external factors to which industrial design students are exposed.

managing information were examined. Representative quotations are presented in Table 8.

The students' descriptions suggest that high and low performers interact with their peers differently. High achievers enjoyed studying together and commenting on other projects motivated them. They liked spending time in the studio. Low achievers preferred to study individually - mostly at home. They expressed feeling psychological pressure when studying in the studio and having low productivity due to other students' presence. They were adversely affected by others' achievements and relieved by the failures of peers. Avoiding interaction with peers indicates problems with the regulation of behaviors such as seeking help.

The descriptions about the feedback (critiques) indicated variety in the students' self-efficacy beliefs. High achievers mentioned that they stayed motivated after harsh criticism, which was more effective and helpful than being praised or gently critiqued. They learned the most from strong criticism. Students emphasized the value of asking for extra comments from the other instructors. Conversely, low achievers mentioned that they were hesitant and avoided meeting the instructors. They became demoralized after harsh criticism and lost their confidence. High achieving students seemed to have greater self-efficacy beliefs than underperformers.

In their third year, the design studio provides students with more opportunities for self-process time,

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which means students need to develop their projects by doing desktop or field research by themselves in addition to homework and feedback from the instructors. When describing their self-process time, differences in the purpose of research became clear. High achievers researched on the Internet after they had decided on their subject. In contrast, low achievers went online to decide their subject. The difference in the purpose of research indicates problems in seeking appropriate information – a sub-dimension of behavioral regulation.

3.3. Integrating the quantitative and qualitative results

To respond to the fifth research question To what extent do qualitative and quantitative results converge?, we merged the quantitative and qualitative databases using a weaving approach that makes intragroup comparisons of the results into a type of narrative integration (see Fetters et al., 2013). We considered the quantitative and qualitative data analysis together on a themeby-theme basis and determined that the qualitative data expanded the findings of the quantitative component. This allowed us to exemplify the statistical differences in the context of studio education and illustrate these differences with essential aspects of Zimmerman's SRL model (see Zimmerman & Moylan, 2009). Some strategies high and low achievers used during their projects were prominent in both data sets (see Table 2). Organizing and transforming, self-evaluation and self-consequences after failure were significantly different for the two student groups. Specific information from interview descriptions related to these aspects. Additionally, planning, task value and attribution for failure were statistically different with supporting descriptions from qualitative data. There were also some inconsistencies in the findings. Despite no statistical differences, our qualitative results revealed differences in seeking assistance, self-efficacy and goal orientation. We discuss these aspects further in the discussion.

4. Discussion 4.1. Main findings

The study aimed to explore differences in SRL strategies and motivational factors between high and low achieving ID students in a studio course. We used a convergent mixed methods design to gain a comprehensive understanding of the students' strategy use. The integrated analysis demonstrated that there were differences between high and low achieving students' SRL skills concerning the use of metacognitive, motivational and behavioral strategies.

Comparing the quantitative and qualitative results illustrated that the metacognitive strategies of organizing and transforming, planning, self-evaluation and self-consequences after failure were different for the two groups in both data sets. High achieving students interpreted project brief, tasks, feedback, experiences drawing or writing, and changed strategy according to their understanding. These findings align with research pointing out the adaptive inferences and SRL patterns of high achieving students (e.g., DiFrancesca et al., 2016; Nandagopal & Ericsson, 2012; Pintrich & de Groot, 1990; Powers, 2006; Zimmerman, 2008). The lack of interpretation deters low achievers from developing their autonomy which is a crucial feature for the creative endeavor in design education (Tudor, 2008). This may explain the dependency of low achievers on external factors such as being easily influenced by examples or praise from others, especially instructors. Design students are expected to be independent, self-analytical and critical thinkers (Tovey, 2015) and the form of studio education generally produces this kind of learners. However, our results demonstrated that students could have very different experiences in the same studio and some struggle to find their way (Shreeve, 2015). These findings may caution studio educators to accept individual differences, engage metacognitive strategies and encourage students to understand their learning journeys.

Within metacognitive strategies, the differences in self-evaluation of the student groups were at a different level. Despite the significant difference in the quantitative analysis, students' descriptions revealed that they were all aware of their strengths and weaknesses. This qualitative result is consistent with Zimmerman and Pons' (1986) self-evaluation finding – the only strategy nonrelated to academic achievement. However, deeper conversations and observations during interviews supported the quantitative results that low achievers were evaluating themselves while answering our question. This confirms the notion that multidimensional assessment approaches have more potential to understand human regulation (see Cleary et al., 2012; Tas & Sungur, 2012) and capture these nuances. Low achieving students complained about the problems they encountered, attributed their weaknesses to the education system, and expected the instructors to teach them how to make self-adjustments and overcome difficulties. In their SRL model, Zimmerman and Moylan (2009) place self-evaluation and casual attribution together due to their interdependence, and our results fit well with that. Attribution to external and uncontrollable factors discourages efforts to develop, undermines self-motivation (Schunk, 2007; Weiner, 1992; as cited in Zimmerman & Moylan, 2009) and reduces ownership which is a motivational necessity for students (Powers, 2006). Self-critique reduces dependence on others and helps develop self-regulatory learning skills (Crolla et al., 2019; Greene, 2018). Our findings indicate that underachieving design students need to be encouraged in self-judgment during the studio process through focusing on controllable causes rather than defensive decisions.

Quantitative analysis revealed motivational factors (task value, attribution for failure and the overall scores) as notable predictors of academic performance. Student interviews enabled us to further discover the differences in goal orientation and self-efficacy factors. Low achievers defined studio success as having positive critique from instructors, which demonstrated their performance-oriented goal.

Their frailty in the face of harsh criticism also indicated low self-efficacy. Our integrated findings support and expand on previous studies mentioning the relationship between motivation, SRL and academic achievement (e.g., Araz & Sungur, 2007; Eckerlein et al., 2019; Erdogan & Senemoglu, 2016; Kryshko et al., 2020; Meece, 1994; Pintrich & Schunk, 2002; Zimmerman, 2000; Zimmerman & Moylan, 2009). Students need to be motivated to navigate the complexity of design education by accepting mistakes, obstacles and risks, and developing methods for handling tasks and self-evaluating learning performances (Fadlelmula et al., 2015; Garner & Evans, 2015; Powers, 2016)

In contrast to quantitative results, qualitative data exemplified differences in behavioral strategies between the high and low achieving groups. High achievers were more open to peer and teacher interaction. They preferred to seek the help of others, study together and believed in learning better in this way. Low achievers were reluctant to have comments from peers or instructors to avoid demoralization. These findings are in line with studies considering these resource management strategies as self-regulatory processes and predictors of academic achievement (e.g., Englert & Mariage, 2003; Greene et al., 2015; Karabenick & Gonida, 2018; Newman, 2008; Zimmerman & Cleary, 2009; Zimmerman & Martinez-Pons, 1990). Reluctance to seek help mostly relates to a lack of awareness of the need for help (Greene & Azevedo, 2009), lack of social competencies or, as stated in interviews, fearing criticism (Karabenick & Knapp, 1988). From this standpoint, problematic communication between underachieving students and instructors should be considered. Critique sessions are the fundamental tool of reflective conversations in studio education. They also improve the metacognitive skills of design students (Greene, 2018). Yet, if the critiques mostly point out weaknesses or mistakes, students may avoid attending the sessions or misinterpret the comments (Goldschmidt et al., 2010). Inaccessibility of the instructors - described as

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'mystery-mastery' syndrome by Schön (1987) may prevent underachieving students from asking for help and decrease their self-confidence. Criticism should be given in a scaffolded manner that supports underachieving students to use external resources appropriately.

The most remarkable result emerging from the qualitative data was the dilemma faced by students. Both high and low achievers reported difficulty in deciding on a strategy for developing their projects, which they described as the dilemma of product vs. meaning. High achievers managed to integrate their ideas - exemplifying a cognitive strategy for critical thinking (Paul, 1989) - but the perception of contradiction caused underachievers to choose what seems easy. These findings broadly follow research showing the correlation between SRL, critical thinking and academic achievement (e.g., Gaythwaite, 2006; Oz, 2019; Paul & Elder, 2005; Phan, 2010; Seferoglu & Akbiyik, 2006). The cognitive strategies such as moving from abstract to concrete, analysis to synthesis or information to interpretation are seen as a skill of critical thinking (Paul & Elder, 2005), a process of innovation (Beckman & Barry, 2007), a creative production (Orlandi, 2010), a representational transformation (Casakin & Goldschmidt, 1999; Oxman, 1999) and a designer's skill (Powers, 2016; Tobón et al., 2021; Voûte et al., 2020). The ability to synthesize and interpret provides students with cognitive strength to deal with the complexity and ambiguity of design projects (Austerlitz et al., 2008; Shreeve, 2011). Fostering SRL strategies in the design studio may help underachieving design students to develop the higher order thinking skills needed to cope with ill-defined problems.

4.2. Limitations and further studies

Our integrative analysis revealed the difficulty in recognizing the SRL skills of students via one kind of data source. On its own, our quantitative data indicated statistical differences in strategy use between the two achievement groups. However, it provided little insight into how and why this occurs. We did not ask about or mention any SRL strategies during interviews, and this enabled us to obtain non-biased descriptions by which we could go beyond statistics and realize other internal and external components that might affect design students' SRL process. The integrated approach led to a reconsideration of the complex and ambiguous design learning process. The inconsistent findings between the data sets (mostly in behavioral and motivational factors) also highlighted an important limitation about self-report for further studies. Some studies have questioned the effectiveness of self-report for capturing factual information (e.g., Winne & Jamieson-Noel, 2002) and dependency on the context of use (e.g., Alexander et al., 2011; DiFrancesca et al., 2016). Even though the questionnaire used in our study was designed as context-free and suitable for [anonymized] undergraduates (Erdogan & Senemoglu, 2016), we had to optimize the terms according to studio expressions. Therefore, it may not completely capture accurate information in a design education context. Future research might therefore benefit from a self-report study with a design-education-oriented approach or using additional SRL measurements that monitor and track learners' ongoing development.

The sample size was constrained to 47 participants completing the questionnaire and 16 participants being interviewed. Our results are promising and should be validated by a larger sample size. Further, our study focused on a small group of junior undergraduates majoring in ID in a [anonymized] university. For this reason, caution is recommended concerning the findings' generalizability and external validity. Future research would benefit from multiple content areas, different design disciplines and students at various levels of study. Aside from a small number of studies, the design domain in SRL studies is under-researched and had not yet been studied in [anonymized]. We believe that our research will serve as a base for future studies on this topic.

4.3. Conclusion

Using a convergent mixed-methods approach, this study has taken steps toward describing differences in the self-regulation skills of high and low achieving ID students in a design studio course. The interview findings expanded the self-report questionnaire results, presented new insights, and provided a detailed understanding of the statistical results. By this study, we anticipate our contribution in two levels. First, it provides insights for education literature from design studio education which is a creativity focused learning environment with natural learning condition and simulation of real-life. Second, regarding the ongoing deep changes in both educational, theoretical and practical sides of design -which is signifying a new order of design and a new generation of designers who tend to become decisionmakers- this study fills a gap within the existing body of design pedagogy and instruction in industrial design relative to self-regulated learning. It highlights the importance of students' self-awareness, strategy preferences and purpose of learning in studio education. Thus, we aimed to better understand design learning and provide further insights for redesigning the studio learning experience. To further our research, we intend to conduct an intervention in a design studio course, where the specific SRL strategies and phases will be integrated into the studio process targeting underachieving students' needs. Design studios will not fulfill their potential to foster SRL skills through the signature pedagogy unless individual student differences are paid attention to. Studio education needs improvement to encourage students to develop their learning skills. The implication of SRL strategies regarding individual differences in design learning environments can help to improve the design performance of less accomplished students.

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A model proposal for university campuses in the context of inclusive design

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Abstract

Urban public spaces should be shaped according to the need as they occupy an important place in urban development. The campuses serve as a small city due to the facilities and social environment they have and thus emerge as important public spaces. Campus areas affect our attitudes towards education and should be tailored to the needs and designed to cover all campus users. As a modern design approach, the inclusive design philosophy; To create quality spaces by increasing the livability and quality of university campuses as a public space, and to spread this philosophy to the whole society in their professional lives by ensuring that this design concept is placed on university students, who are the main campus users, who will provide the development of the society. It is to determine the problems faced by the users in the university campuses, research the approaches and examples that will allow all users to access the campus equipment, use this equipment as they wish, and develop solutions for the problems encountered. This study aims to create an evaluation model to create an inclusive campus environment. The creation of the checklist, which was prepared as a priority, as detailed in the field study. The field study continued with the implementation and results of the checklist in the selected Davutpaşa campus. The fieldwork carried out in the Davutpaşa campus was divided into four categories: psycho-social arrangements, administrative arrangements, outdoor and indoor physical arrangements.

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Keywords

Architectural design, Inclusive design, Campus climate, Universal design.

1. Introduction

The public spaces of the city, where the social relations of members of the society take place intensively, occupy an important place in urban development. The cultural, economic, and technological conditions in constant change and development, as well as the understanding, needs, and use of public spaces are affected by this situation.

The philosophy of inclusive design as a modern design approach; The main objectives of this research are to create quality spaces by increasing the liveability and quality of university campuses as public spaces and to spread this philosophy throughout the society, by placing this design concept on university students in their professional lives, who are the main campus users, and who will ensure the development of society.

Public spaces of the city should be shaped according to the need of the populace, as they occupy an important place in urban development. The campuses serve as a small city due to the facilities and social environment they have and thus emerge as important public spaces. Campus areas affect our attitudes towards education and should be tailored to the needs of, and designed to cover, all campus users.

University campuses, with their urban equipment, sociocultural environment, and user diversity, are important public spaces in the case of small city examples. Campus areas affect our attitudes towards education. Although very few designers are now designing campuses by adopting human-centred design, this nonetheless needs to be included in the whole process. Human-centred designs begin by taking into account the needs of students and educators who are actual campus users, enabling the field to support learning transformation.

The inclusive environment is unhindered in order to ensure equal opportunities and participation by all. Design is more than form and function; it is about changing people's perceptions and how such impressions interact with the environment. An obstacle that prevents people from fully taking part in society is based on the interaction between the individual and the built environment. People of different abilities, sizes, and ages must be able to fully participate in society independently. Inclusive Education begins with teaching tolerance for those who are different within one's own environment and covers a large spectrum of individual differences such as age, gender, and ability/ disability as well as ethnic, cultural, linguistic, and religious background (Hick et al., 2009; Lunt, & Norwich, 2009; Florian, 2009; Fredericson & Cline, 2009; Kugelmass, 2004).

'Climate' at a university campus is a term used to refer to how individuals and groups experience the environment within the campus community. This is a general term that summarises the organisation's dynamics of inclusiveness and the extent to which various stakeholders are involved or excluded. Since the conversations about climate are naturally concerned with the real and perceived realities of different groups, this idea always includes social identities defined in terms of race, ethnicity, gender, sexuality, disability, and an unlimited spectrum of other aspects (Williams, 2010).

The campus climate results in a diversity of individuals of different backgrounds. On the other hand, climate expresses the experience of individuals and groups on campus and the nature and scope of the interactions among these various groups and individuals. In other words, the campus climate is an important and necessary component of a comprehensive plan for diversity. To form the basis of a learning community, the primary mission of the academy should be to create an environment that fosters diversity and understands difference.

2. Inclusive campus climate

The historical context in the campus climate includes research into the inclusion or exclusion of different groups in campus culture, traditions, and policies. The structural or compositional dimension expresses the number of various groups present and, in many respects, affects the psychological and behavioural dimensions; in short, it shows how individuals behave and perceive the campus environment. Structural diversity represents the true representation of different groups on a campus. The psychological dimension is related to how much individuals feel belonging or excluded and the behavioural dimension is affected and represents the interaction between different groups.

Studying campus climate and culture is an important part of campus-based conceptual assessment. A culture of data-driven approach is adopted to create a more comprehensive campus environment. When campus climate research is well done, an equal environment will be created for the campus community, faculty, staff, women, minorities, LGBT community members, and others.

The university brings together individuals from different sociocultural settings. At the same time, the university contributes to the personal and intellectual development of individuals and serves as a field of socialisation. Universities create vitality with their social, cultural, economic, and spatial effects.

It is an undeniable fact that the social and cultural environment in the university gives differences to the perspectives of individuals. The campus environment, where people from different ideas come together and find opportunities to socialise, accommodates many cultures. Zhang et al. (2017) argued for the design education aim should be transferred from design solution centered to human-centered. Our future younger designers should not think from themselves but have a holistic understanding of people. The inclusive design concept and thinking should be merged into design education aim. For example, we can state "to cultivate future designers more concern about diverse human capabilities and various human needs".

Inclusive design refers to products and areas that are available to everyone. There is a misconception that inclusive design is often associated with accessibility for the disabled or the aging population. In fact, inclusive design not only addresses the needs of people with disabilities but also includes various target groups such as children, families and the aging population (Imrie, 2012).

Psychological and behavioural dimensions are often the focus of most of the campus climate research. When the psychological dimension of the campus climate is mentioned, it is perceived how individuals perceive (a) the conflict and discrimination on campus, (b) the background or (c) institutional support/commitment to diversity. Behavioural dimensions of campus climate, interactions between different groups; reports on participation in activities (or lack thereof) and full participation in various systems of the organisation (Williams, 2010).

Since inclusive buildings serve a purpose that meets a variety of needs, the shape-to-function approach should be adopted. The form-following function is a design principle invented by Louis Sullivan, which means that the shape of the building is determined by internal activities or purpose (Week 13, 2018). Rather than seeking information from people's cognitive minds, they are provided with environmental perceptions and insights guided by motivation and previous experiences (Steinfeld & Maisel, 2012). Therefore, the architecture of the extensively designed structures should indicate the purpose of the building to provide information for the benefit of the user by the administration.

Built-in forms should communicate in built-in buildings because this understanding facilitates security and usability for everyone. Buildings usually consist of rooms with interrelated functions. According to Roth, there are four types of functions in architecture: pragmatic, circulatory, symbolic and psychological; inclusive buildings should transmit psychological and circulatory function, which is the creation of appropriate spaces to regulate and direct movement from one area to another (Roth, 1993).

The physical form of campuses is one of the most important factors in creating a positive first impression of an institution among prospective students (Boyer, 1987; Griffith, 1994; Thelin & Yankovich, 1987). In the basic layout of the campus, the quality of the open spaces, the accessibility of parking spaces and living rooms, and the design of buildings such as libraries or student clubs come to the fore.

The impact of the physical environment on behaviour can be conceptualised. The physical environment

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may be the source of opportunities or may affect the likelihood of some behaviour. For example, having a convenient and attractive collection area at the core of the campus increases students' socialisation on campus; or having off-campus sports facilities may reduce the likelihood of using the facilities. Although the characteristics of the campus physical environment include theoretically all possibilities, the layout, location and arrangement of spaces and facilities may make some behaviours more likely and more likely than others. The recent and developing concept of inclusive education aims to provide equal opportunities to students with diverse abilities in a shared school environment. Inclusive education at schools creates the challenge of comprehensive institutional reformations and demands adaptations in physical school environments as a form of urban space diversity. Schools are being challenged to review their curriculum, organizations, pedagogical structures in order to fulfill the requirements of inclusion (Erkilic, 2012).

Vehicle-pedestrian distinctions have an important place in campus planning. As a result of the movement within a macro-scale environment, people perceive and recognise this environment as both physically and psychologically salient. This movement can be thought of as pedestrian-oriented because, when a person walks around, they can get to know their environment in the best way and communicate with other people and objects. In recent urban designs, it is observed that pedestrian-scale urban spaces, which are free of motor vehicles, are given priority to pedestrians. While this pedestrianisation operation is carried out in the regions within the existing city, this principle is very important in the newly established cities or parts of the city. In this context, when examining university campuses, an important feature is that; This means that a student can move between two extreme faculties in a 10-15-minute period between two courses (Kortan, 1978).

The impact of university campus design can be understood from a pedestrian perspective (Banning, 1993). A good campus not only provides a

Figure 1. Creating a social space from the circulation area (Wong, 2014).



safe, convenient, and enjoyable walking paths for pedestrians but also adds to the feeling of being involved in the walking experience, i.e., the feeling of space and learning (Strange & Banning, 2001). The harmony in the architectural design of the buildings and the landscape of the campus can enhance the feeling of the place. In addition, a legible campus spatial structure can increase the likelihood that students will engage in a variety of intellectual activities on campus. Locating the main library with an accessible entrance on the main pedestrian path can encourage students to enter the building and use its resources.

However, among the many methods used to promote learning, the use of the physical environment is perhaps the most neglected feature. As can be seen in Figure 1, it is possible to create a social environment from the circulation areas and provide interaction. The combination of circulation and social spaces has a beneficial effect.

As well as being part of the urban environment, the campuses have an urban area with their functions, landscape, circulation areas, and landscapes. In this context, environmental perception can be mentioned in order to express the perceptibility of the campus. When the campus structures are evaluated from this perspective, the campuses constitute a perception with their education - housing - recreation sports units, green spaces and circulation areas. Another phenomenon that has an important place in the perceptibility of the campus is circulation. As a result of human movement in the environment, people perceive visual, physical and psychological.

A good perception of the campus environment can be achieved by planning the circulation in the best way. In addition, movement detection, which is the main element of circulation, becomes even more powerful (Cinar, 1998). The campus transportation system is not limited to transportation elements.

The most important feature of inclusive campus interiors is circulation and consequently good orientation. In addition to architectural design, pathfinding is also effective in communicating and meeting various needs. Pathfinding is defined as a variety of ways to navigate by people to become familiar with their environment (Nussbaumer, 2012). Pathfinding is considered to be another form of communication system integrated into buildings designed as inclusive. Each floor is given an identity and is presented with a signage system to improve people's experiences. Routing is also important because it creates identity within the building.

Combining multiple senses seeking clues to construct a mental map through perception in extensively designed buildings ultimately creates situational awareness driven by previous experiences (Steinfeld & Maisel, 2012). Sound, light, colour and texture function have an impact on the quality and availability of inclusive buildings.

As understood from the literature study the university brings together individuals from different socio-cultural environments, contributes to the personal and intellectual development of individuals and serves as a field of socialisation. The concept of inclusive design has emerged to ensure that individuals benefit equally from all opportunities. The inclusive environment ensures equal opportunities and participation. Inclusive design is not only an architectural problem, but also a political, economic, social and technological issue. Inclusive campus Climate is a term used to discuss how individuals and groups experience the environment in the campus community. The students with various disabilities, who were seen as one of the most disadvantaged groups in society, faced the problems of educational marginalization and exclusion in their learning environment. A demand for a new paradigm that would improve both the special education and existing education systems has resulted in a shift of value systems in educational institutions from segregation to inclusion (Erkilic, 2012).

The campus climate includes the diversity of individuals and their experiences and communication between individuals. The campus environment should be the place where all individuals, with or without disabilities can receive education together. It is a social responsibility for individuals with disabilities to receive a better education, and it is necessary to provide solutions in order to prevent the right of individuals with disabilities to improve their education and to revise their educational structures projects in this respect. In the campus environment, the cultural environment is directly related to the behavioural and psychological environment. The psychological dimension of the campus environment is related to discrimination and diversity on campus. The behavioural dimension is related to the interaction and socialisation environment between different groups. As the physical environment may be the source of some opportunities or may affect the likelihood of some behaviour, campus building is an important factor for inclusiveness. Although the characteristics of the campus physical environment theoretically include all possibilities, the layout, location, and arrangement of spaces and facilities can make some behaviours more likely and more likely than others. The campuses create a perception with their work, education, shelter, sports units, green spaces and circulation areas. Another phenomenon that has an important place in the perceptibility of the campus is circulation. As a result of human movement in an environment, the environment is perceived visually, physically, and psychologically. In the case of creating accessible environments that can be used by everyone, the integration of circulation spaces and social spaces is more ideal for sustaining social interaction.

3. A case study

With the comprehensive design approach, the status of all users' access to and use of the campus areas was evaluated with the checklist created and the questionnaire extracted from this list. The campus design checklist created within the scope of the doctoral thesis contributed to the literature as an original study.

In the selection of Yıldız Technical University Davutpaşa Campus,

- the demand for the university,
- the diversity and surplus of the user profile,
- the recent reconstruction of the campus planning,
- the ongoing construction of new buildings in line with the needs,
- the urgent solution of the regulations in the campus area,

brought by rapid developments in terms of the inclusive design concept were among the important factors.

This study includes physical arrangements in the field, data collection through on-site observations, and evaluation in the context of the created checklist. Photographing the data obtained includes identifying problems and opportunities through technical observation. The checklist created in the study area was taken into consideration. As a result of the literature study, questions were created for the inclusive campus environment; items required for the campus environment were formed from the questions in the existing checklists. In order to make better observations during the study, a questionnaire was designed from the checklist and a questionnaire was administered to academic staff, administrative staff, and students. The results of this survey were drawn up with the statistical package program and interpreted.

The framework prepared for the campus environment is as follows: In this context, the campus environment was examined under three main headings. University campuses have been examined conceptually, managerially, and physically, and the checklist prepared in the field study section was formed according to the components of inclusive campus environment design (Table 1).

These sections are designed to be applicable to each university campus in order to be under the same roof as the Inclusive University Campus Environment segment in Section 2 (selected as the sample area investigation of Davutpaşa campus). All open areas of the Davutpasa campus have been examined and Faculty of Arts and Sciences building and Faculty of Electrical and Electronics building have been examined. In the selection of the refectory and library buildings, it was recognised that these were important common areas to be used by all students and staff living in the campus. The selection of the Faculty of Science and Letters, as well as the Faculty of Electrical and Electronic were quite important given the high number of students studying in these faculties. For this reason the fact that the surveys were too high in these faculties and that the buildings were built for this campus later than the others.

The questionnaire applied in the field study was produced from the questions in the checklist. In the context of inclusive design, the students and administrative and academic staff working at Davutpaşa campus were surveyed face to face and on the internet to represent their main masses. The deficiencies and qualifications of the Davutpaşa campus were evaluated and the results of the quantitative research were analysed using two-step clustering analysis, chisquare independence test, factor analysis and t test for independent samples.

The questionnaire administered to the students was conducted using a faceto face-interview method; respondents were asked to answers each question

Table 1. Inclusive campus environment components.

Conceptual Environment								
	777							
Cultural Environment	Social Environment	Psychological Environ	ment					
	Administrative Envi	ronment						
Inclusion Objective and Perception	Economic Factors	Legislation on Inclusive Design	Accreditation					
Physical Environment								
Interior Space		Outdoor Space						

Table 2. Open field and structures clustering analysis position variable results.

		Position			Tetel		
				Student	Administrative	Academic	Total
			Count	78	7	13	98
O p		1	% within Position	34,80%	70,00%	41,90%	37,00%
e	TwoStep		Count	74	1	6	81
n	Cluster Number	2	% within Position	33,00%	10,00%	19,40%	30,60%
Г			Count	72	2	12	86
i		3	% within Position	32,10%	20,00%	38,70%	32,50%
e			Count	224	10	31	265
l d	Total		% within Position	100,00%	100,00%	100,00%	100,00%
s					Position		Tetal
t				Student	Administrative	Academic	Total
r			Count	128	1	10	139
u	TwoStep	1	% within Position	47,60%	6,70%	25,60%	43,00%
c	Cluster —		Count	141	14	29	184
t u	Number	2	% within Position	52,40%	93,30%	74,40%	57,00%
r			Count	269	15	39	323
e s	Total		% within Position	100,00%	100,00%	100,00%	100,00%

Table 3. Open field and structures clustering analysis experience variable results.

				Exp	perience	T-4-1
				1-4 year	4+ year	TOLAI
			Count	60	38	98
		1	% within Experience	33,00%	45,80%	37,00%
	TwoSten		Count	61	20	81
O p	Cluster Number	2	% within Experience	33,50%	24,10%	30,60%
n			Count	61	25	86
F		3	% within Experience	33,50%	30,10%	32,50%
i		Total		182	83	265
e I d	Total			100,00%	100,00%	100,00%
				Experience	Experience	
				1-4 year	4+ year	lotal
			Count	105	34	139
S t	TwoStep	1	% within Experience	47,10%	34,00%	43,00%
u	Number		Count	118	66	184
c t		2	% within Experience	52,90%	66,00%	57,00%
u			Count	223	100	323
r e s	Total		% within Experience	100,00%	100,00%	100,00%

carefully. The personnel survey was conducted on the Internet using the Surveymonkey platform system. The obtained data tables were uploaded to the statistical package program in Excel-file format and necessary statistical analyses were performed.

Seven demographic variables were identified and analysed according to these variables. These variables were position (student-staff), experience (1–4 years, 4+ years), faculty (Faculties of Science, Literature, Electrical Electronics, Construction, Chemistry Metallurgy, Education, Economics and Art Design), gender (male-female), disability status (exist-none), disability type (orthopaedic, vision, hearing, neurological and other disability types), graduation (high school, associate, university, graduate).

The questionnaire was applied to 384 students and 75 staff. Although a questionnaire was sent to all personnel via the Internet, only 75 of them were returned. The questionnaire was applied to 459 people in total; there were 23 disabled people. Four of the participants are in orthopaedic disabilities, seven were visually impaired, one was hearing impaired, one had a neurological disability, and 10 of them are in the other disability group.

3.1. Clustering analysis in the context of open spaces – physical arrangements

Questions about open areas were included in the cluster analysis. As a result of clustering analysis, it was determined that three clusters had good decomposition; the participants were divided into three groups. In clustering analysis, the distinction of clusters was made according to the scores given in the questionnaire. The answers to the survey questions were coded as follows: 1 (Very low), 2 (Low), 3 (Medium), 4 (More), 5 (Too much). Of the clusters formed as a result of clustering analysis, the questions included in the first cluster analvsis were between 1.00 and 2.50 points (dissatisfied), 2. Cluster 2.50 and 3.50 points (moderately satisfied) consisted of those whose responses derived a score between 3.50 and 5.00 (satisfied). The following cluster distribution table shows the cluster profiles.

Clustering analysis was performed using questions about open spaces and structures/physical arrangements. Cluster profiles obtained as a result of the research were determined according to position, experience, faculty, gender, disability status, disability type, and graduation variables.

When the answers given to the physical competence questions in open spaces were evaluated according to the po-

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students were in the dissatisfied group, variable results. 33% were in the most satisfied group, and 32.1% were in the middle group. 70% of the administrative staff were in the dissatisfied group, 10% in the satisfied group, 20% in the middle group. 41.9% of the academic staff were in the dissatisfied group, 19.4% in the most satisfied group, 38.7% in the middle group. While 70% of the administrative staff were in the dissatisfied group, 34.8% of the students were in the dissatisfied group. The majority of the academic staff appeared in the dissatisfied and middle groups; the percentage in the most satisfied group was low (19.4%). It was seen that the students groups and the percentage between variable results. the dissatisfied and the satisfied group was very close to each other. When the general population was examined, it was seen that the majority (37%) were in the dissatisfied group.

When the answers given to physical competence questions in open areas were evaluated according to the experience variable (Table 3), it was seen that dissatisfaction increased as the years of experience increased. The distribution of clusters in the 1-4 year experience range is close to equality. For those who had more than 4 years of experience, 45.8% dissatisfied group, 24.1% most satisfied group and 30.1% medium satisfied group. Thirty-seven percent of the total was found to be in the dissatisfied group.

When the answers given to the physical competence questions in open spaces were evaluated according to theFaculty variable (Table 4), 66.7% of the Faculty of Art and Design, 42.2% of the Faculty of Construction and 42.6% of the Faculty of Electrical and Electronics were found to be not dissatisfied. With 41.9%, the Faculty of Education was the most satisfied group. The Faculty of Arts and Sciences was in the middle group with 45.2%.

When the answers given to physical competence questions in open spaces were evaluated according to the gender variable (Table 5), it is seen that there is not much difference between men and women. The general attitude was found to be in the dissatisfied group

sition variable (Table 2), 34.8% of the Table 4. Open field and structures clustering analysis faculty

			Faculty							
			Science Literature	Electric Electronic	Building	Chemistry Metallurgy	Education	Economy	Art and Design	Total
TwoStep Cluster : Number		Count	10	20	19	15	12	14	8	98
	1	% within Faculty	23,80%	42,60%	42,20%	34,90%	38,70%	31,10%	66,70%	37,00%
	2	Count	13	12	11	16	13	15	1	81
		% within Faculty	31,00%	25,50%	24,40%	37,20%	41,90%	33,30%	8,30%	30,60%
		Count	19	15	15	12	6	16	3	86
	3	% within Faculty	45,20%	31,90%	33,30%	27,90%	19,40%	35,60%	25,00%	32,50%
Total		Count	42	47	45	43	31	45	12	265
		% within Faculty	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
			Faculty							
			Science Literature	Electric Electronic	Building	Chemistry Metallurgy	Education	Economy	Art and Design	Total
	1	Count	29	27	11	22	24	25	1	139
TwoStep Cluster Number		% within Faculty	54,70%	44,30%	20,80%	41,50%	60,00%	51,00%	7,10%	43,00%
		Count	24	34	42	31	16	24	13	184
	2	% within Faculty	45,30%	55,70%	79,20%	58,50%	40,00%	49,00%	92,90%	57,00%
		Count	53	61	53	53	40	49	14	323
Total		% within Faculty	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

were distributed almost equally to the Table 5. Open field and structures clustering analysis gender

		G	Total		
		Female	Male	TOLAI	
	Count	41	57	98	
1	% within Gender	36,60%	37,30%	37,00%	
TwoStop	Count	32	49	81	
Cluster 2 Number	% within Gender	28,60%	32,00%	30,60%	
	Count	39	47	86	
3	% within Gender	34,80%	30,70%	32,50%	
	Count	112	153	265	
Total	% within Gender	100,00%	100,00%	100,00%	
		Gender		T-4-1	
		Female	Female Male		
	Count	61	78	139	
1 TwoStep	% within Gender	43,60%	42,60%	43,00%	
Number	Count	79	105	184	
2	% within Gender	56,40%	57,40%	57,00%	
	Count	140	183	323	
Total	% within Gender	100,00%	100,00%	100,00%	

with 37%, in the most satisfied group with 30.6% and in the middle group with 32.5%.

When the answers given to physical competence questions in open areas were evaluated according to the Disability variable (Table 6), it was observed that the type of disability is important (Table 7). 58.3% of the disabled were in the dissatisfied group. 25% of the disabled were in the most satisfied group. 50% of the visually impaired were in the dissatisfied group, 25% in
Table 6. Open field and structures clustering analysis obstacle variable results.

				Obsta	de (Y/N)	10	
				Unimpede d	Disabled	Total	
			Count	91	7	98	
		1	% within Obstacle (Y/N)	36,00%	58,30%	37,00%	
	TwoStop		Count	78	3	81	
O p	Cluster Number	er 2 ber	% within Obstacle (Y/N)	30,80%	25,00%	30,60%	
n			Count	84	2	86	
F		3		33,20%	16,70%	32,50%	
1			Count	253	12	265	
e I d	Total		% within Obstacle (Y/N)	100,00%	100,00%	100,00%	
1				Obsta	Obstade (Y/N)		
				Unimpede d	Disabled	Total	
			Count	134	5	139	
S t r	TwoStep	1	% within Obstacle (Y/N)	43,40%	35,70%	43,00%	
u	Number		Count	175	9	184	
c t	Hamber	2		56,60%	64,30%	57,00%	
u	8		Count	309	14	323	
r e s	Total		% within Obstacle (Y/N)	100,00%	100,00%	100,00%	

Table 7. Open field and structures clustering analysis obstacle type variable results.

			×	Obstacle Type					Tet	Tetel	
				0	Orthopedic	Seeing	Hearing	Other	106	41	
			Count	76	1	2	1	3	83		
			% within Obstacle Type	34,70%	33,30%	50,00%	100,00%	60,00%	35,80	9%	
	TwoStop		Count	72	0	1	0	2	75		
O p e	Cluster Number	2 % within Obstacle Type		32,90%	0,00%	25,00%	0,00%	40,00%	32, 30	9%	
n F			Count	71	2	1	0	0	74		
		3	% within Obstacle Type	32,40%	66,70%	25,00%	0,00%	0,00%	31,90	9%	
1		Count			3	4	1	5	232		
e I d	Total		% within Obstacle Type	100,00%	100,00%	100,00%	100,00%	100,00%	100,0	0%	
· · · · ·				0 () 0			7.4.1				
				0	Orthopedic	Seeing	Hearing	Other	Neurological	Total	
			Count	124	0	3	0	1	1	129	
S t r	TwoStep	1	% within Obstacle type	47,10%	0,00%	60,00%	0,00%	100,00%	20,00%	46,40%	
ŭ	Number		Count	139	3	2	1	0	4	149	
c t	Number	2	% within Obstacle type	52,90%	100,00%	40,00%	100,00%	0,00%	80,00%	53,60%	
u			Count	263	3	5	1	1	5	278	
r e s	To	tal	% within Obstacle type	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	

the middle group, and 25% in the most satisfied group. 66.7% of the orthopaedic disabled people were in the middle group and no one in the satisfied group. The most satisfied group consisted of one visually impaired and two other disabled groups.

When the answers given to the physical competence questions in the open areas were evaluated according to the graduation variable (Table 8), it was found that the high rate of the dissatisfied group was Associate and University. It is seen that graduate students are equally distributed to clusters.

3.2. Structures-physical arrangements cluster analysis

In the clustering analysis, questions about structures physical arrangements were included. As a result of the clustering analysis, it was determined that two clusters had good decomposition; the participants were then divided into two groups. In clustering analysis, the distinction of clusters is made according to the scores given in the survey. The results of the clustering analysis consisted of those who scored between 2.50 and 5.00 points (satisfied) and those who scored between 1.00 and 2.50 points (unsatisfied). The following cluster-distribution table shows the cluster profiles.

Clustering analysis was performed using questions about structures and physical arrangements. Cluster profiles obtained as a result of the research were sorted according to position, experience, faculty, gender, disability status, disability type, and graduation variables.

When the answers given to the physical competence questions in the structures were evaluated according to the position (unit of study) variable (Table 2), the majority of the administrative and academic staff appeared in the dissatisfied group. Of the administrative personnel, 6.7% were in the satisfied group and 93.3% were in the dissatisfied group. Of the academic staff, 25.6%n were in the satisfied group and 74.4% were in the dissatisfied group. 47.6% of the students were in the satisfied group and 52.4% were in the dissatisfied group. It was seen that over 90% of the votes of the administrative staff expressed satisfaction with the structures. Also, the academic staff were generally satisfied with the structures but the distribution of the students was different.

When the answers given to the physical competence questions in the structures were evaluated according to the experience variable (Table 3), the results were more negative in the highly-experienced (dissatisfaction among those with more than 4years experience). 2.

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The rate of negativity in the cluster was high: 47.1% of those with experience between 1–4 years were in the satisfied group and 52.9% were in the dissatisfied group. Of those who had more than 4 years of experience, 34% were in the satisfied group and 66% were in the dissatisfied group.

When the answers given to the physical competence questions in the buildings were evaluated according to the faculty variable (Table 4), 92.9% of the Faculty of Art and Design were not satisfied. The majority of the Faculty of Civil Engineering was also dissatisfied (79.2%). On the whole, 57% were not satisfied and 43% were satisfied.

When the answers given to the physical competence questions in the structures were evaluated according to the gender variable (Table 5), this factor was very close to each other in both clusters.

When the answers given to the physical competence questions in the structures were evaluated according to the Disability variable (Table 6), 64.3% of the disabled individuals and 56.6% of the unhindered individuals came out of the dissatisfied group. 100% of orthopedically disabled people were not satisfied. Of the visually impaired were in the satisfied group. Visually-impaired people were more satisfied than physically disabled people: 80% of other disabled people emerged in the dissatisfied group (Table 7).

When the answers given to the physical competence questions in the buildings were evaluated according to the graduation variable (Table 8), the dissatisfaction rate in associate degree, university, and graduate students was higher than the high school. In the general evaluation, while the percentage of dissatisfied was 43%, the rate of dissatisfied was 57%.

3.3. Open areas and structures physical regulation questions personnel factor analysis

In the personnel satisfaction questionnaire, subdimensions were investigated using factor analysis of open spaces and structures physical regulations questions. As a result of factor analysis, five factors explaining all variables were obtained and evaluated. The first factor consisted of the variables related to the

Table 8. Open field and structures clustering analysis graduation variable results.

					Graduat	ion			
				High school	Associate	License	Graduate	Total	
			Count	69	4	13	12	98	
		1	% within Graduation	35,90%	50,00%	41,90%	35,30%	37,00%	
	TwoStop		Count	61	1	8	11	81	
O p	Cluster Number	ster 2 nber	% within Graduation	31,80%	12,50%	25,80%	32,40%	30,60%	
n			Count	62	3	10	11	86	
F		3	% within Graduation	32,30%	37,50%	32,30%	32,40%	32,50%	
-		Total % wi Grac		192	8	31	34	265	
l d	Total			I % within Graduation		100,00%	100,00%	100,00%	100,00%
					20102 10				
				High school	Associate	License	Graduate	Total	
			Count	110	5	12	12	139	
s t	TwoStep	1	% within Graduation	47,60%	33,30%	30,80%	31,60%	43,00%	
u	Cluster		Count	121	10	27	26	184	
c t	- Marrison	2		52,40%	66,70%	69,20%	68,40%	57,00%	
u			Count	231	15	39	38	323	
r e s	Total		% within Graduation	100,00%	100,00%	100,00%	100,00%	100,00%	

dimensional properties of the space, the second factor consisted of the variables relating to the social space, the third factor was the emergency variables, the fourth factor comprised the variables related to entrances and transportation, and the fifth factor involved all variables related to the circulation areas.

In the first factor, in general, the questions of Group B (structure analysis) came together with the dimensional-physical questions. In the second factor, Group A (open spaces) questions related to social spaces were gathered. In the third factor, questions related to emergencies in Group B questions came together, but this group also participated in the question about the parking area. In the fourth factor, the questions related to the transportation and entrance to the campus and within the campus were gathered. In the fifth factor, the Group A questions included circulation areas and circulation questions within the campus.

According to factor analysis, Factor 1 was the most important campus assessment factor for personnel because of its dimensional characteristics.

3.4. Open areas and structures physical regulation questions student factor analysis

In the student satisfaction questionnaire, subdimensions were investigated using factor analysis of open spaces and

Table 9. Staff and student factor analysis comparison table.

	Staff	Student
Factor 1	Dimensional Properties	Circulation and indoor features
Factor 2	Social places	Social places
Factor 3	Emergency components	Emergency components
Factor 4	Entries and transportation	Entries
Factor 5	Circulation areas	Transportation

structures physical regulations questions. As a result of factor analysis, five factors explaining all variables were obtained and evaluated. The first factor was composed of variables related to circulation areas and indoor characteristics, the second factor was related to social spaces, the third factor related to emergency variables, the fourth factor related to entries, and the fifth factor was related to transportation.

In the first factor, general circulation group questions (Group A; open spaces) and Group B (structure analysis) questions related to circulation and interior features were gathered. In the second factor, questions belonging to Groups A and B, relating to social spaces, were gathered. In the third factor, questions related to emergencies were brought together in Group B questions; however, this group also participated in finding directions. In the fourth factor, questions relating to the entrance of Group A questions and the question about the parking area were gathered. In the fifth factor, transportation questions were gathered from Group A questions on the campus.

According to factor analysis, the most important campus evaluation factor was found to be circulatory and indoor characteristics due to Factor 1 circulation and indoor features. When the factor analysis tables were compared, according to the staff and student satisfaction survey, it was seen that the most important factor for the staff was dimensional characteristics. The most important factors for the student were circulation and interior features. In the Table 9, it was seen that the question groups appeared similar after the second factor. For the staff and students, the second factor social spaces, the third factor emergency components and the fourth factor entries. Table 9, Factor 5 for the differentiated staff in close proximity to each other factor 5 circulation areas, transportation for students has emerged.

4. Discussion

Although the doctoral thesis study of KTO Karatay University, which is examined with photographs, is similar to this study in terms of content, it is divided based on the methods used. In the study, which was carried out only on photographs, a unique checklist was not used, and the results were obtained without conducting a survey (Okten, 2018).

According to the research conducted by Mengi (2019), the expectations of disabled students from the university; to provide equal access to every area (classrooms, washrooms, buildings, cafes, etc.) and information (course materials, library, etc.) in the campus, and to receive services that suit their needs, especially in student affairs. He also stated that they have expectations such as creating environments where they can spend their free time, have fun, rest, socialize and culture, and raise awareness for people with disabilities.

In the study of Pauya and Kocaaslan (2020), to reveal the problems faced by the disabled students at İnönü University on the campus, observations and on-site inspections determined the places that could cause problems for the disabled, and suggestions were developed for the campus to be barrier-free. The question-naire method and a unique checklist were not used in this study. Within the scope of the study, only the physical environment analysis was made according to the universal design principles.

As a result of the surveys applied to staff and students, when the physical competence questions in open areas were evaluated,

- The distribution of the students in groups was equal,
- The majority of the administrative personnel were in the dissatisfied group,
- While the percentage of academic staff was expected to be higher for the dissatisfied group, the percentage was lower than the administrative staff.
- According to the experience variable, dissatisfaction increased as the time spent on campus increased,
- According to the faculty variable, the most dissatisfied group was the Faculty of Art and Design,
- The majority of the Faculty of Education was in a satisfied group.

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- According to the gender variable, while researchers expected women to be more sensitive, there was no significant difference between women and men,
- According to the disability variable, there was a significant difference between the results.
- According to the graduation variable, graduate students were expected to be more sensitive and aware, while they were equally distributed among the groups.

As a result of the questionnaire applied to staff and students, when the physical competence questions in the buildings were evaluated,

- The majority of the administrative and academic staff were in the dissatisfied group,
- Half of the students were in the dissatisfied group,
- According to the faculty variable, it is seen that the Faculty of Art and Design is not satisfied with the structure of more than 90%,
- There was no significant difference between women and men according to the gender variable.
- According to the obstacle situation, the majority did not make a difference, the majority were in the dissatisfied group,
- In terms of graduation, dissatisfaction rates of associate degree, university and graduate groups were higher.

When the overall assessment is made, it is observed that open spaces and structures need to be restructured in order to satisfy the user.

As a result of the survey applied to staff and students, according to factor analysis;

- While social spaces are expected to be the most important factor for students, circulation and indoor characteristics of the most important factor are observed.
- For the personnel, it was observed that the most important factor involved dimensional characteristics, that is, they experienced difficulties in this regard,
- It has been seen that social spaces are the second factor for the student and staff group.
- The fact that the entries are in the

last rankings for the students is not important for them and the features of the spaces are more important.

- While it is expected that the circulation areas will be more important for personnel, it has been revealed that they give more importance to emergency components,
- The most important factor for students was transportation, which means that they did not experience any problems.

When both groups were compared, it was considered that the interior features, circulation areas and dimensional characteristics should be reviewed. The study is an objective study based on statistical data. The context of the original checklist it contains has created a model base for inclusive campus design in the literature.

5. Conclusion

University campuses are defined as the reflection of the land (area and all structures), the academic village or academic ideals established in a green area to the physical planning of the buildings that make up a university, and the social activities that can be integrated into the society by being socialised are also performed.

For this reason, it is evident that university campuses, as with all other public spaces, can be used by everyone on equal terms (and should be considered as spaces designed and implemented with a design approach with unobstructed equipment). Product and physical environments designed according to user profiles such as disabled / disabled, elderly, children, overweight people, very tall or very short people, pregnant women, load carriers other than the average user needs that are the target of general design criteria; It is certain that it will meet the needs of all segments of society due to its inclusive structure.

The concept of inclusive design, which has emerged as the answer to these design concerns, is the design of products, structures and environments that can be used by as large a population as possible, taking into consideration diversity and being accessible. The aim of inclusive design is to design accessible and usable environments for everyone, regardless of their ability and competence level. It is the essence of the concept of inclusive design to produce products and structural environments that can be used by everyone instead of designs for different needs. To this end, inclusive design principles and guidelines help educate both designers and consumers about

more available design solutions. In the context of the inclusive campus environment design checklist created as a result of the literature review, when designing an inclusive campus environment; circulatory network and landscape integrity should be taken into consideration, inclusiveness should not be ignored in the teaching environment.

When an inclusive design is adopted and planned in the campus design, an environment will be created in which individuals coming to the campus will be strengthened, satisfaction will increase for both employees and students, and social capital and community feeling will be felt more intensely. In line with the surveys targeting the answers to diversity in the university, the university's identity will be strengthened in this way, and it will gain wealth due to the satisfaction of diversity. The inclusive design should aim to create a university environment that embraces everyone.

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The meaning of green campus in UI GreenMetric World University Rankings perspective

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Abstract

The higher education institution sector has recently been recognized as an influential hub for sustainability innovation and education by considering the most critical sustainability challenges. It represents an invaluable chance to facilitate the essential generational change towards a more sustainable approach in life. Universities provide innovative approaches to sustainable development by pushing the envelope of practice and exploring new frontiers of knowledge. Furthermore, these institutions pave the way for breakthroughs and trend-setting findings to be transitioned to other implementations within the built environment; hence, communities become capable of learning and gradually developing the culture of sustainability. On a global scale, numerous universities have embarked on missions to create green campuses, known as a way to seek sustainability initiatives in universities. This research aims to expose the definitions and parameters of the green campus approach from the viewpoint of UI GreenMetric World University Rankings as one of the assessment tools specializing in evaluating green campus initiatives. This research shows that the GreenMetric functions as a guide which encourages universities to integrate sustainable development into their practices; since its categories are devised following sustainable development goals. In this research, the green campus approach is defined through investigating the Green-Metric approach regarding sustainability on university campuses by clarifying the reasons for its categorization that encompasses all university dimensions, including education, research, operation, outreach, assessment, and reporting. The study is conducted through an integrated review of literature focusing on higher education institutions' sustainability to investigate the green campus concept's historical, contextual, and evolving nature.

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Green campus, Sustainable development, UI GreenMetric World University Rankings.

1. Introduction

The critical challenges of sustainable development movements have challenged the agendas of governments, organizations, corporations, and institutions, including higher education institutions (HEIs), to be aware of their sustainability responsibilities. Changing individuals' and organizations' mindsets takes a long-term effort at all levels, so HEIs are recognized as drivers of achieving a bright sustainable future through a paradigm shift. That is to say, HEIs' prominent role in the enhancement of sustainable development has become certain (Corcoran & Wals, 2004; Disterheft et al., 2013; Lukman & Glavic, 2006; Thomashow, 2014). Universities and colleges, as the educators of the majority of society's leaders, are profoundly responsible for raising awareness, knowledge creation, technological advancement, innovations, and tools required for a sustainable future (Wright, 2002; Clarke & Kouri, 2009; Bettencourt & Kaur, 2011; Thomashow, 2014). Therefore, it is a moral responsibility of HEIs to increase public awareness of sustainability and to cope with barriers of environmental, social, and economic developments as they are capable of influencing sustainable development advancement (James & Card, 2012; Filho et al., 1996; Cortese, 2003).

Several authors contended that universities are laboratories to practice sustainability initiatives (Shriberg & Harris, 2012; Verhoef & Bossert, 2019). In this sense, a university campus can be a research center not only to implement environmental projects but also to build up the knowledge and skills in students leading to profound changes and, consequently, to adopt sustainable behavior in their own lifestyle (Shriberg & Harris, 2012; Tukker et al., 2008; Jackson, 2011). Universities are essential transformational sites, as they are known as centers of discourse, education, and innovation. Therefore, they are living laboratories allowing teaching, learning, and research within a system known as a model for the community beyond the university (Filho et al., 2019). Since "Higher education has unique academic freedom and the critical mass and diversity of skills to develop new ideas, to comment on society and its challenges,

and to engage in bold experimentation in sustainable living" (Cortese, 2003, 17).

Accordingly, universities pave the way for breakthroughs and trend-setting findings to be transitioned to a range of other applications within the built environment; hence, the communities can learn and gradually develop a culture of sustainability in the long run. In this regard, as leaders in research, education, and innovation, they are important places to address global issues and encourage progressive action within current and future generations (Moore, 2005; Clarke & Kouri, 2009). There is no sustainable world if universities do not promote sustainability (M'Gonigle & Starke, 2006). Moreover, "...no institutions in modern society are better situated and more obliged to facilitate the transition to a sustainable future than colleges and universities" (Orr, 2002, 96).

Seeking sustainability at universities is possible by creating green campuses. It should be noted that the terms green campus and sustainable campus are used interchangeably; studies in literature covering sustainability in HEIs used both terms. It is worth noting that although green and sustainability, especially in respect to university campuses, encompass the same scopes in studies, they differ to some extent. Based on the study done by Yanarella et al. (2009), who asserted that sustainability distinguishes itself from green in that, conceptually, the latter focuses on one of the pillars, namely environmental or economic, while sustainability balances on three pillars: environmental, social and economic known as "triple bottom line" (Elkington, 1999). The authors continued that the significant difference between these two terms lies in the scope and scale they operate, which does not necessarily mean that green operates on one pillar or dimension without considering the more extensive system (Yanarella et al., 2009). Therefore, to eliminate ambiguity concerning these terms, the scope and scale need to be determined, particularly in research studies. Since this study reviews green campus's meaning in the GreenMetric perspective, and the rankings system with its presented domains clarifies focuses on all three pillars of sustainable development in university campuses, and the campus itself embeds an extensive system, the term green campus is used throughout the study as a holistic and multidisciplinary term embracing different, however, connected aspects.

The green campus concept is a more recent field of study, and there has been a mounting demand for transforming university campuses into green campuses. Consequently, numerous Universities have begun to figure out and act upon their sustainability responsibilities by implementing policies in their practices to fulfill sustainability ambitions (Johnston, 2012; Swearingen White, 2014). Indeed, universities have commenced following up on sustainability ideas in their strategies and trying to initiate actions to thwart the adverse impacts on the environment (Ceulemans et al., 2011; Lozano et al., 2015; Shephard & Furnari, 2013). On the way to achieving a green campus, HEIs' sustainability assessment tools play a crucial role. They guide in respect to the domains where sustainability initiatives need to be applied; moreover, they are platforms for self-evaluation and dissemination of the latest knowledge and information regarding green campus implementations. As one of the HEIs sustainability assessment tools, the GreenMetric, which is specialized in evaluating green campus initiatives, has encouraged universities to integrate sustainable development into their practices by guiding universities to apply sustainability initiatives within specific domains, including Setting and Infrastructure (SI), Energy, and Climate Change (EC), Waste (WS), Water (WR), Transportation (TR), Education and Research (ED); each category consists of indicators and criteria with apportioned points that demonstrate their importance.

Accordingly, this study reviews these domains presented in the latest version of the GreenMetric (2020) to determine how they serve HEIs to change their status to green campus by investigating their conformity with sustainable development goals (SDGs) and underlying each indicator's and criterion's essentiality for the integration of sustainable development into HEIs. Additionally, the study examines the GreenMetric

approach regarding university dimensions, including education, research, operation, outreach, assessment, and reporting, to underscore its criteria and indicators' adaptability to these dimensions. Therefore, investigating each category's aim and scope through literature will define green campus from the GreenMetric viewpoint. Moreover, in a broader context, the study aims to acknowledge that by using the Green-Metric framework, HEIs can adopt green initiatives and move towards sustainable development. Consequently, the study is conducted through an integrative review of the literature focusing on higher education institution sustainability to investigate the historical, contextual, and evolving nature of the green campus concept.

2. Integration of sustainable development into HEIs

According to the etymology of the word sustainability, it can be understood that it consists of two words: to sustain and ability. The first part of the word is derived from the Latin word "sustinere"; -tenere, which refers to the verb hold. It also has been defined as to maintain, retain, support, and endure. In more general terms, sustainability is the endurance of systems and processes (Parker, 2017). Concerning Parker's definition of sustainability, it is comprehendible that the broad meaning can extend to every system and be associated with processes that support lives. Hawken (2007) stated that sustainability is about the balance between two complicated systems of the earth, including the human culture and the living world, which are currently in a disruptive relationship. As a straightforward explanation, it is said that sustainability enhances the quality of human life by improving living standards while considering ecosystems' capability with quantifiable limits to support (Milne et al., 2006).

As the rate of change and complexity in many dimensions, such as the environment, society, and technology, is accelerating, the sustainability subject has become urgent (Stephens et al., 2008). As evidence shows, it is obvious that the future will not look like the past; hence, this indicates the burgeoning need for sustainability (Gilding, 2012). The concept of sustainability is a centerpiece and has changed individuals' and organizations' relations with the surrounding environment and its embodied environmental, social, and economic aspects radically.

However, the idea of being responsible for preserving the source for future generations dates back to the mid-17th century by the emergence of two chief concepts: "bon ménage" and "bon usage", which mean good housekeeping and good use respectively, and later became the inspiration source for the terms "wise use" and "sustainable development" in the 20th century (Grober, 2007). The original version of the word sustainability made its debut in print in a comprehensive handbook of forestry in 1713, in which Hanns Carl von Carlowitz derived benefit from two sources: John Evelyn (1664) and Jean Baptiste Colbert (1669), as they dealt with the question of achieving conservation of timber in a way that there would be a continuous, constant, and sustained use. Accordingly, the origin of the word sustainable comes from a sector related to forestry (Wiersum, 1995) and is derived from the German term "Nachhaltiger Ertrag" which means "sustained yield" (Wilderer, 2007); it is referred to the idea of equilibrium between the consumption and the reproduction of resources to avoid long-term depletion (Van Zon, 2002). These words also describe sustainability: "To fulfill our obligations to our descendants and to stabilize our communities, each generation should sustain its resources at a high level and hand them along undiminished. The sustained yield of timber is an aspect of man's most fundamental need: to sustain life itself" (Duerr, 1975, 36).

By the end of the twentieth century, the discussions around environmental, socio-cultural, and socio-economic issues, which are profoundly rooted in equity and equality in the world, have engaged the minds of intellectuals and decision-makers to pave the way through the arrival of a new idea, sustainable development, which was the outcome of a series of conferences, international bilateral agreements, and summits. Ultimately, sustainable development was defined by The World

Commission on Environment and Development (WCED) in the Brundtland Report with the title of Our Common Future. The commission successfully unified environmentalism with social and economic concerns on the world's development agenda and defined sustainable development explicitly by these words: "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). It should be acknowledged that, before what was expressed by Brundtland Report about sustainable development, in a book titled "Limits to Growth" (1972), the earth's capacity to provide humans' basic needs was discussed, and sustainable development was described implicitly. In the Brundtland Report, the main pillars of sustainable development, including economic, social, and environmental protection, which are known as the initial phase for the evolution and the improvement of a strategic perspective concerning sustainability, have also been determined. The definition and pillars have played a catalytic role in promoting the subsequent adoption of two overriding concepts: giving priority to the world's poor and providing their basic needs, and determining the role of all kinds of organizations in limiting the boundaries of their actions on the environment in order not to prevent the ability of the environment to meet present and future needs (Bac, 2008). It is worth noting that the term sustainability is an objective of humanities toward human-ecosystem equilibrium (homeostasis). Sustainable development paves the way to reach sustainability aims by encompassing a holistic approach and temporal processes (Shaker, 2015). Almost three decades later, in 2015, sustainable development goals (SDGs), which are also known as Global Goals, a set of seventeen interconnected goals, were devised by The United Nations General Assembly to be a blueprint to achieve a better and more sustainable future all by the year 2030. The SDGs have a multidisciplinary approach addressing interlinked issues and demanding interconnected governance responses (Stevens & Kanie, 2016).

Consequently, sustainable development has become the center of thoughts and actions on every scale, including global, regional, and local, with various approaches to drive the idea into implementations. As stated by Bettencourt and Kaur (2011), "the concept of sustainable development ... now pervades the agendas of governments and corporations as well as the mission of education and research programs worldwide" (p. 19540).

The first declaration that drew attention towards the importance of education in fostering environmental protection and conservation was the declaration of the United Nations Conference on The Human Environment, known as the Stockholm Declaration (Lozano et al., 2015) in 1972. This declaration has been signed by several universities around the world voluntarily, which is an indication of their commitments toward sustainability (Wright, 2002; Filho, 2011; Tilbury, 2012). Brundiers et al. (2010) stated that the Stockholm Declaration has pointed to sustainability matters of HEIs in general, but it also created a basis for subsequent detailed declarations regarding sustainability in HEIs. Following the Stockholm Declaration, the Belgrade Charter (1976) was also influential in pointing out the development of environmental education internationally. In the following year, the Tbilisi Declaration (1977) introduced five notions of environmental education goal to become the basis for the development of global environmental education, including consciousness, knowledge, attitude, skills, and engagement (Zhang, 2006). The Tbilisi Declaration's main focus was solely on sustainability in education, and it was not an outcome of a university sector conference.

Nevertheless, it gave momentum to later sustainability in HEIs' declarations (Calder & Clugston, 2003; Wright, 2004), which emerged more than a decade later in the early 90s (Wright, 2004). In the following part, early declarations that addressed sustainable development in HEIs and were outcomes of conferences held solely by the university sector are highlighted. They have profoundly influenced the emergence of further events and declarations on the crucial role of HEIs in sustainable development so far.

The Talloires Declaration (1990), which focuses on environmental degradation, natural resource depletion, pollution, and threats facing biodiversity and human survival, presents a ten-point action plan to incorporate sustainability and environmental literacy into teaching, research, operations, and outreach of HEIs. Moreover, it emphasizes the need for transdisciplinarity and sustainable development implementation throughout all campus practices (Lozano et al., 2013). The Halifax Declaration (1991) has similar targets and contents to the Talloires Declaration; it presents a comprehensive action plan that determines short- and long-term goals at each local, regional, and global scale. Moreover, it underlines HEIs responsibilities related to raising awareness of environmental degradation, unsustainable environmental practices, and impacts of poverty on sustainable development by focusing on the curricula, operations, and outreach. The Kyoto declaration (1993) emphasizes the definition of sustainable development presented in the Brundtland Report and targets to urge universities for sustainable utilization of resources, encourage people to prevent practices against sustainability, persuade academics to integrate sustainability subject in research and teachings, promote universities to apply sustainable development throughout campus operations, strengthen cooperation with the community, and urge interdisciplinary networks of environmental experts from a local to a global scale. The Swansea declaration (1993) is an outcome of a conference with the theme of People and the Environment - Preserving the Balance, held by the Association of Commonwealth Universities (ACU), which took steps to gather people affiliated with the universities to share their own experiences and actions regarding changing the status of their universities to sustainable. The declaration's scope and focus are similar to the Kyoto declaration and address the curricula, research,

operations, and outreach. Copernicus - The University Charter for Sustainable Development (1994)- addresses the challenges that universities face and outline a framework in which they need to tackle those difficulties regarding sustainability implementations. It urges HEIs to implement ten principles of action plans which consists of institutional commitments, environmental ethics, university employees' education, environmental education program, interdisciplinarity, dissemination of knowledge, networking, partnerships, continuing education programs, and technology transfer. Along with these declarations, which are known as the initial ones regarding sustainability in HEIs, sustainability-based partnerships and associations, such as Global Higher Education for Sustainability Partnership (GHESP), International Sustainable Campus Initiative (ISCN), and The International Alliance of Research Universities (IARU), have also emerged.

3. Green campus: An approach to sustainable development in HEIs

Although the word green literally represents a specific spectrum of color, it indicates verdure, vivacity, and vitality in a broader sense. Concerning its conceptual meaning, the term green has been widely used in various disciplines, from business practices to design and products, to express benefits to the environment. It has been diffused within an even broader context as "green economy". It was in the early 90s that the term green was first used in concepts related to HEIs in the form of the greening of the universities, but later, especially after 2010, it evolved into more particular concepts, such as green campus, green university, and green curriculum (Atici et al., 2020). The word green can be described as a conceptualized word related to sustainability.

The emergence of the green campus concept is an outcome of the debates on encompassing sustainability initiatives in university campuses. It has significantly gained momentum since the declarations on sustainable HEIs (Grindsted & Holm 2012). By realizing that universities contribute to environmental degradation through their activities, green campus initiatives have emerged since greening is the first step universities take towards sustainability (Jain & Pant 2010; Alshuwaikhat & Abubakar, 2008; Bernheim, 2003; Her- remans & Allwright, 2000). As a university campus consists of transportation systems, buildings, landscape, water, and energy infrastructures, which consume large amounts of natural resources and emit greenhouse gases, they are similar to cities (Blackburn, 2007; Alshuwaikhat & Abubakar, 2008). Razavivand Fard et al. (2019) noted that since the sustainability concept emphasizes the matter of wellbeing and quality of life and it ensures urban livability, it is also applicable to the university campus environment; however, it is of great importance to address the particular physical and functional parameters of each university campus setting.

Green campus initiatives have become essential components of current university systems as a response to impacts of human activities on the environment; therefore, the investment in building green campuses is recognized as the most promising due to its highest and the most long-lasting effects (Richardson & Lynes, 2007). The term green campus is defined in the literature as a place where environmental, economic, and social aspects need to be taken into consideration throughout all activities to achieve an ecologically sound, socially and culturally just, and economically viable place (Bekessey et al., 2003; Velazquez et al., 2006). The greening of higher education institutions diminishes the environmental impacts of campus decisions and activities and promotes environmental awareness within HEIs communities (Creighton, 1999). Therefore, the green campus provides leadership by example for society (Amaral et al., 2015), as it is a way to disseminate information about sustainability. Green Campus is a laboratory of self-scrutiny, experimentation, and application. At its best, it is a model where operational planning, business practices, academic programs, and people are interlinked to provide educational and practical values to the institution, region, and the world.

4. A framework for green campus initiatives: HEIs sustainability assessment tool

HEIs sustainability assessment tools operationalize declarations and charters of sustainable development in HEIs (Shriberg, 2004). They clarify the subfields under the domains in which sustainability practices have to be applied and elucidate the process. Alonso-Almeida et al. (2015) underlined the pivotal role of sustainability assessment ranking systems as a reporting tool that documents current sustainability practices and alludes to using the results in qualitative and quantitative methods in future sustainability implementation. The authors argued that "a sound sustainable development vision requires clear reporting to inform the HEIs stakeholders of the benefits of sustainable development by concerning their role in highlighting the sustainable development vision" (Alonso-Almeida et al., 2015, 152). The definite categorization presented in these ranking systems can alleviate concerns related to the ambiguousness of sustainability standards and operations; moreover, they can ease the way to find the proper method to transition universities into green campuses. Discovering best practices and utilizing them as a guide to commence sustainability practices in universities are the reasons to invest in sustainability assessment tools (Shriberg, 2004). Shriberg (2004) argued that there is a necessity of employing such assessment tools because HEIs need to compare their methods with each other, which results in developing a vision related to university campuses' sustainability to verify and guarantee the path they are moving along. Meanwhile, the potential of sustainability assessment in urging organizational change towards sustainability has been pointed by several authors (Lambrechts & Ceulemans, 2013; Ramos & Pires, 2013).

In sum, HEIs sustainability assessment tools

- outline the domains sustainability initiatives should be applied
- provide a platform for participation on a global scale via the Online Reporting Tool
- offer the opportunity to various universities with different systems and

contexts to share their results

- gather and document information about the universities' sustainability initiatives and performance
- scrutinize the information accuracy and assure that this information meets the requirements
- present a report to receive public recognition
- alleviate the discontinuity between the theory of sustainability idea in university campuses and application of sustainability practices
- demonstrate similarities and diversities between processes and methods
- help the development of strategies and enhancement of practices
- strengthen cooperation and collaboration among universities for a common goal
- present easily interpretable information on the standing of universities
- encourage competitions among higher education institutions
- promote transparency

5. UI GreenMetric World University Rankings

UI GreenMetric World University Rankings is one of the self-evaluative cross-institutional sustainability assessment tools of green campuses which measures sustainability efforts. This ranking system persuades universities to share their data and information regarding sustainability practices in an online platform for further evaluations and translation into rankings. Moreover, it provides valuable information on the breadth and depth of campus sustainability activities. As a non-profit institution, which was launched in 2010 by Universitas Indonesia (UI), it is influenced by the heated topic of integration of sustainable development on university campuses and is in line with Education for Sustainable Development (ESD) (GreenMetric Guideline, 2020).

During the first year of its introduction, 95 universities from different countries applied to be ranked. However, the number of participants increased almost tenfold by 2020, reaching 911 universities. The total number of nations applied to the GreenMetric in 2010 was 35, whereas it has multiplied to 83 nations in 2020. Indeed, the GreenMetric has accomplished the target of urging as many universities from different regions of the world. Although the number of countries in 2020 is fewer than the previous year, the exponential growth is apparent during the ten-year interval. Consequently, the GreenMetric has become a valid assessment tool for evaluating and improving green campus initiatives globally. The number of universities and nations that participated in the competition from 2010 until 2020 are demonstrated in Table 1.

As shown in Table 2, the GreenMetric consists of 39 criteria and indicators within six main categories. Each category has its points and influence rate in total; the points are apportioned to all indicators in the categories according to their significance. The first category, known as setting and infrastructure, with an influence rate of 15 percent in total scoring, contains six indicators with total points of 1500. The energy and climate change category includes eight indicators with total points of 2100 and an influence rate of 21 percent in total scoring, which is the most pivotal among others. The waste, transportation, education, and research categories are weighted as 18 percent with total points of 1800 each. 6, 8, and 7 indicators are allocated to them respectively. The water category comprises four indicators; besides 1000 points, an influence rate of 10 percent in total is associated with this category, which places it as the least effective within six categories.

Cortese (2003) stated that a university consists of a four-dimensional system including education, research, campus operations, and community outreach, to which sustainability initiatives should be applied to build a green campus. These four dimensions also were the focus of declarations regarding sustainability in HEIs. Later Lozano-Ros (2003), in his study, added a fifth dimension and claimed that the four dimensions needed to be assessed and reported. Accordingly, the Green-Metric provides a tool for looking at all dimensions of university campuses, including education, research, campus operations, outreach, assessment, and reporting to boost sustainability knowledge, strategic planning and operation,

Table 1. The number of universities and nations participating in the GreenMetric during 2010-2020. (Adapted from https:// greenmetric.ui.ac.id. Copyright 2020 by UI GreenMetric World University rankings.)

	Number of	Number of
Year	universities	nations
2010	95	35
2011	178	42
2012	215	49
2013	301	61
2014	360	62
2015	407	65
2016	515	75
2017	619	76
2018	719	81
2019	780	85
2020	911	83

Table 2. UI GreenMetric World University rankings system categorization and indicators. (Adapted from UI GreenMetric World University Rankings guideline, 2020).

Categories	No	Criteria and Indicators	Points	Total
Setting and	SI 1	The ratio of open space area to the total area	300	
Infrastructure	SI 2	Total area on campus covered in forest vegetation	200	
(SI)	SI 3	Total area on campus covered in planted vegetation	300	
Weighting 15%	SI 4	Total area on campus for water absorption besides the forest and planted	200	
	SI 5	The total open space area divided by total campus population	300	
	SI 6	Percentage of university budget for sustainability efforts	200	
		within a year	200	1500
Energy and	FC 1	Energy efficient appliances usage	200	1000
Climate	EC 2	Smart building implementation	300	
Change (EC)	EC 3	Number of renewable energy sources in campus	300	
Weighting 21%	EC 4	Total electricity usage divided by total campus' population	300	
it eighting 21/0	201	(kWh per person)	200	
	EC 5	The ratio of renewable energy production divided by total	200	
		energy usage per year		
	EC 6	Elements of green building implementation as reflected in all	300	
		construction and renovation policies		
	EC 7	Greenhouse gas emission reduction program	200	
	EC 8	The total carbon footprint divided by total campus	300	
		population		2100
Waste (WS)	WS 1	Recycling program for university's waste	300	
Weighting 18%	WS 2	Program to reduce the use of paper and plastic on campus	300	
	WS 3	Organic waste treatment	300	
	WS 4	Inorganic waste treatment	300	
	WS 5	Toxic waste treatment	300	
	WS 6	Sewage disposal	300	1800
Water (WR)	WR 1	Water conservation program & implementation	300	
Weighting 10%	WR 2	Water recycling program implementation	300	
	WR 3	Water efficient appliances usage	200	
	WR4	Consumption of treated water	200	1000
Transportation	TR 1	The total number of vehicles (cars and motorcycles) divided	200	
(TR)		by total campus population		
Weighting 18%	TR 2	Shuttle services	300	
	TR 3	Zero Emission Vehicles (ZEV) policy on campus	200	
	TR4	The total number of Zero Emission Vehicles (ZEV) divided	200	
		by total campus population		
	TR 5	Ratio of ground parking area to total campus' area	200	
	TR 6	Program to limit or decrease the parking area on campus for	200	
		the last 3 years		
	TR 7	Number of initiatives to decrease private vehicles on campus	200	
	TR 8	Pedestrian path on campus	300	1800
Education and	ED 1	The ratio of sustainability courses to total courses/subjects	300	
Research (ED)	ED 2	The ratio of sustainability research funding to total research	300	
Weighting 18%		funding		
	ED 3	Number of scholarly publications on sustainability	300	
	ED 4	Number of events related to sustainability	300	
	ED 5	Number of student organizations related to sustainability	300	
	ED 6	University-run sustainability website	200	
	ED 7	Sustainability report	100	1800

and foster cross-sector dialogue about sustainability on campus and stimulate collaboration between HEIs. The adaptability of the GreenMetric criteria and indicators to university dimensions is illustrated in Figure 1.

The criteria and indicators used in this ranking system are developed in accordance with three main constituents of the sustainable development concept: environmental, economic, and social (Suwartha & Sari, 2013). Accordingly, it can be concluded that the GreenMetric categorizations are in line with SDGs. The conformity of the GreenMetric categories with SDGs is shown in Table 3.



Figure 1. The conformity of the GreenMetric criteria and indicators with university system dimensions.

GOAL 9: Industry, Innovation and Infrastructure

GOAL 11: Sustainable Cities and Communities

GOAL 16: Peace, Justice and Strong Institutions

GOAL 17: Partnerships for the Goals

GOAL 12: Responsible Consumption and Production

GOAL 10: Reduces Inequalities

GOAL 13: Climate Action

GOAL 15: Life on Land

GOAL 14: Life Below Water

5.1. Setting and infrastructure (SI)

Within the six indicators of the SI categories, the most important ones are related to open spaces, forest, and planted vegetation areas within the campus, which emphasizes the importance of green spaces. "Open space," "open areas," and "public space" are other terms frequently used instead of green spaces (Cilliers, 2015). Green spaces are defined as public or private spaces covered by vegetation serving in two ways: directly, which is about active or passive recreation, or indirectly, which means having positive impacts on the urban environment (Cilliers, 2015). Accordingly, SI underscores necessary actions that should be taken to preserve existing green areas and create new ones in a campus environment. As previously mentioned in Table 2, the SI category is devised according to SDG's numbers 3, 4, 13, and 15. In the following parts, the SI approach to these goals is underlined.

Green spaces serve as opportunities for enhancing students' awareness regarding local biodiversity and its management (Speake et al., 2013). Also, being exposed to nature boosts the student's ability to learn about environmental matters (Brandli et al., 2020). Green spaces can improve social interactions by functioning as recreational and relaxing areas (Woolley, 2003). Reducing stress levels and increasing

Waste (WS)

Water (WR)

Transportation (TR)

Education and Research (ED)

Sustainable Development Goals	UI Greenl	UI GreenMetric World University Rankings				
		Categories				
GOAL 1: No Poverty	GOAL 3					
GOAL 2: Zero Hunger	GOAL 4					
GOAL 3: Good Health and Well-being	GOAL 13	Setting and Infrastructure (SI)				
GOAL 4: Quality Education	GOAL 15	-				
GOAL 5: Gender Equality	GOAL 7					
GOAL 6: Clean Water and Sanitation	GOAL 9					
GOAL 7: Affordable and Clean Energy	GOAL 13	Energy and Climate Change (EC)				
GOAL 8: Decent Work and Economic Growth	GOAL 6					

GOAL 9

GOAL 11

GOAL 12

GOAL 6

GOAL 12

GOAL 14

GOAL 15

GOAL 3

GOAL 10 GOAL 11 GOAL 13

GOAL 15

GOAL 4

Table 3. UI GreenMetric World University rankings system categorization and indicators. (Adapted from UI GreenMetric World University Rankings guideline, 2020).

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self-esteem are the benefits of being in touch with green areas (Cammack et al., 2002; Kaplan, 1973; Lewis, 1978). According to Ulrich (1979), interaction with vegetation results in more calm and relaxing feelings for students in stressful situations. Students who are more in interaction with green spaces and use them frequently have a higher quality of life than those who do not (McFarland et al., 2008). Recent experimental works on school environments indicate that green spaces in the vicinity of schools enhance academic achievement. Factors needed for success at schools, including concentration performance and low levels of stress, are associated with the restorative impact of interaction with nature (Becker et al., 2017). Furthermore, green spaces in the surrounding places where people live and work will stimulate physical activities (Hansmann et al., 2007; Owen et al., 2004).

Additionally, green spaces are also recognized as practical solutions to deal with environmental problems. Therefore, land use management regarding green spaces is essential for shaping the urban environment (Steiner, 2014). In general, the environmental benefits of green spaces are as follows:

- Biodiversity maintenance (Farinha-Marques et al., 2011; Hodgkison et al., 2007); since green spaces can function as "wildlife corridors" or act as "urban forests", they can preserve viable populations of species that would otherwise disappear from the built environment (Byrne & Sipe, 2010). Therefore, the more green spaces, the more living spaces with better situations will be. That is an excellent example of "the more, the merrier".
- Mitigation of urban heat island effect and microclimate stability (Alexandri & Jones, 2008; Akbari et al., 2001); as green spaces manage to lower temperatures within their vicinity by evaporative cooling and shading (Shashua-Bar & Hoffman, 2000; Skoulika et al., 2014; Bowler et al., 2010) energy consumption of cooling will be diminished. According to several studies, the temperature of more dense urban green areas is lower than non-green urban areas

(Padmanabhamurty, 1990; Heisler & Wang, 1998; Yilmaz et al., 2007; Huang et al., 2008).

- Pollution reduction and air quality enhancement (Bolund & Hunhammar, 1999; Konijnendijk et al., 2013; Setälä et al., 2013); green spaces capture carbon dioxide from the atmosphere, which diminishes pollution and results in the improvement of air quality (Davies et al., 2011). They also positively influence global warming and help the mitigation of climate change (Paoletti et al., 2011). Also, soil contamination removal through the phytoremediation process is another example of the efficiency of green spaces (Reichenauer & Germida, 2008).
- Reduction of noise pollution (Watts et al., 2013; Veisten et al., 2012); green spaces provide a relaxing place for people to relieve their stress since they are characterized by a pleasant acoustical environment with natural sounds (van Kempen et al., 2014). They help absorb sounds and block the higher frequencies (Dimitrijević et al., 2017) and act as buffers against noise created in the urban environment (Yang et al., 2011; Veisten et al., 2012).

5.2. Energy and climate change (EC)

Creighton (1999) asserted that HEIs contribution to ecological footprint by using electricity, fossil fuels, water, and chemicals is more extensive than any other entity in a community. Electricity is their primary energy carrier and its associated emissions and fuel consumption, along with transportation, and waste management, result in greenhouse gas emissions (Aroonsrimorakot et al., 2013). University campuses' energy consumption is one of the primary greenhouse gas emission sources in the absence of renewable technologies on campus (IARU, 2014). Therefore, university campuses are identified as places to evaluate energy efficiency policies and sustainability implementation (Agdas et al., 2015). Among the GreenMetric categories, the highest score has been assigned to EC, which indicates its significance. Since climate change jeopardizes species survival, actions need to be taken to reduce carbon footprint. On that account, the GreenMetric make universities compete by placing carbon footprint indicator as a leverage point to compute and rank universities (Mohammadalizadehkorde & Weaver, 2018). EC, in line with SDGs numbers 7, 9, and 13, emphasizes practices, which are recognized as effective ways to slow or reverse the climate change impacts on university campuses. These practices include:

- Renewable resource usage, in other words, usage of alternative clean fuels instead of fossil fuels and coal as well as substituting conventional equipment with energy-efficient appliances, which are recognized as effective ways to reduce greenhouse emissions (Toman, 2001).
- Green buildings' element implementation (Brown & Southworth, 2008), forasmuch as the green building initiative urges energy-efficient designs; they enable conditions for reduction of waste production, hazardous materials, and energy consumption (Alshuwaikhat & Abubakar, 2008). Mohammadalizadehkorde and Weaver (2018) also stated that actions regarding buildings' energy performance are recognized as a relatively immediate intervention that can be useful for universities to consume energy more sustainably.
- Smart building implementation, which is identified as "a building which controls its own environment" and characterized by benefits including "predictive maintenance," "energy-saving," "effective monitoring," "optimized site cleaning," and "redesigned space" (Rameshwar et al., 2020).

5.3. Waste (WS)

Today's communities' consumption trend produces a substantial amount of waste which has an adverse impact on the environment besides the negative influence on the socio-economic aspect of society. In addition to the fact that sources are not infinite, it is a challenge for authorities to manage the generated massive waste in an efficient and environmentally responsible way (Zaman & Lehmann, 2011). Therefore, sustainable waste management is an important factor in achieving sustainable development and needs to be considered by all community entities. It focuses on the collection, transfer, processing, recycling, and disposal of waste generated by human activities to ease the burden on landfills, conserve natural resources and save energy (Wan et al., 2019). Moreover, it reduces the negative impact on human health and preserves the visual quality of the environment (Popescu et al., 2016).

Since universities produce a substantial amount of waste, programs regarding recycling and treatments of waste need to be among the concerns of universities. However, HEIs are aware of the responsibility and have begun to implement integrated sustainable waste management programs, as it is a way to show their commitment to environmentally sound practices (Armijo de Vega et al., 2008). On this account, the GreenMertic in WS category, in accordance with SDGs numbers 6, 9, 11, 12, emphasizes programs of recycling waste and reducing paper and plastic usage, along with focusing on actions regarding organic, inorganic, and toxic waste treatment as well as actions concerning sewage disposal.

Lehman defined sustainable waste management as a way to turn waste into a resource (Lehmann, 2010). As an effective process to decrease the amount of waste that goes through disposal processes, such as landfills or incineration, in other words, changing waste to resource, universities use bin infrastructure for waste stream segregation that efficiently helps waste be recycled or reused. Additionally, via this action, organic, non-organic, and toxic wastes are separated and handled by the university itself by available technologies within the university campus or handed over to a third party for reuse, recycle or disposal. Moreover, the GreenMetric, by drawing attention to the implementation of programs regarding the reduction of paper and plastic usage on campus, urges universities to slow down waste generation. For instance, policies on double-sided printing, reusable bags,

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free water distribution, recycled cups usage instead of plastic ones, and dematerialization of administrative procedures are among programs related to sustainable waste management on university campuses.

Also, the matter of sewage disposals is significant for university campuses and should be considered. Therefore, instead of conventional treatment or being transported directly into waterways with no intervention, the sewage should be treated to be reused, downcycled, or upcycled. In the absence of technologies for sewage treatment on a university campus, delivering it to wastewater-treatment centers through a sewer system is a useful action to minimize environmental impacts.

5.4. Water (WR)

In recent decades due to the population explosion, the importance of water management has been increased, as water is one of the basic survival needs. Water management is recognized as one of the main factors of sustainable development and is an efficient way to face water shortage and preserve freshwater supplies (EL-Nwsany et al., 2019). The most critical sustainability issue of universities, depending on climate and location, is the matter of supplying and conserving adequate potable water; therefore, water management becomes essential to achieve sustainability in universities (Dave et al., 2014). Besides waste management, water management can also produce significant monetary savings. Therefore, water-efficient initiatives should be incorporated into the practices of university campuses since water is a natural source and should not be wasted (IARU, 2014). Moreover, the actions regarding water management in universities are initiating a movement towards a behavioral change of water consumption (EL-Nwsany et al., 2019; Faghihimani, 2010). In this regard, the GreenMetric, in its fourth category, in conformity with SDGs numbers 6, 12, 14, and 15, urges universities to reduce water usage on campus by increasing conservation and recycling programs, along with using water-efficient appliances and consuming treated water.

Water management on university campuses generally includes an imple-

mentation to reuse and recycle potable water for potable or non-potable purposes (Dave et al., 2014). Initiatives on campus facilities, such as installing lowflow water fixtures, waterless urinals, and automatic sensors on sinks, are considered as water efficiency actions (Rappaport & Creighton, 2003). The collection of rainwater and stormwater for irrigation (Creighton, 1999), and proper landscape design with drought-resistant native plants and grass are among practices of water conservation on university campuses (Bardaglio & Putnam, 2009; Alshuwaikhat & Abubakar, 2008). Utilization of recycled water and treated wastewater for irrigation and capturing greywater from showers, sinks, and lavatories to use in water closets are also considered as practices regarding sustainable water management on university campuses (Bardaglio & Putnam, 2009).

5.5. Transportation (TR)

The transportation sector, via greenhouse gas emission, negatively impacts the environment and is known as one of the factors responsible for the increase in carbon footprint. Therefore, concerns about climate change have converged to generate an increasing interest in alternatives recognized as sustainable transportation. Green or sustainable transportation refers to certain systems that serve for sustainable development (Jha et al., 2014) by taking into account the triple bottom line: environmental, social, and economic. It is identified as the transition from "vehicle-oriented" to "people-oriented" (Zhang et al., 2010). Sustainable transportation preserves humans' health and their environment in a way that economic progress will be continued and community balance will be met. The transportation system has become a significant feature of university campuses since users engaging in campus activities need to commute to and from campus. Therefore, to achieving sustainability on university campuses and to commit to the path of sustainable development, sustainable transportation should be taken into account by HEIs. The GreenMetric advocates sustainable transportation on university campuses by focusing on SDGs numbers 3, 10, 11, 13, and 15. It encourages universities to operate policies on using Zero-Emission Vehicles (ZEV), applying pedestrian path policy on campus, implementing transportation programs to limit or decrease the parking area on campus, and using shuttle services and transportation alternatives to reduce the number of private vehicles on campus. Since alternative transportation initiatives provide safe and comfortable routes for campus users with the minimum level of impact on human and environmental health (Krueger & Murray, 2008), as they are characterized by low emission, low energy consumption, and low pollution.

Universities by providing bicycling designated walking opportunities, paths, and public transportation, such as shuttle services, which are all under the umbrella term green transportation (Martins et al., 2018) as well as vehicles with green technologies that run on electric, alternative fuel, or human-powered known as alternative transportation, (Krueger & Murray, 2008) can ease traffic congestion and reduce emission (Li, 2016). Consequently, it alleviates urban pollution and environmental problems. Moreover, universities can use carpooling and ride-sharing programs on campuses (Bardaglio & Putnam, 2009). All these actions are effective ways to reduce the number of private vehicles and solve related parking accommodation issues (Toor & Havlick, 2004). In addition to considering pedestrian policies on campuses to provide a safe place for users, a barrier-free landscape under the umbrella of universal design principles must also be considered in the design of roads and pedestrian pathways within university campuses.

5.6. Education and Research (ED)

Moving along with sustainable development and consequently providing a sustainable settlement for humans to live relies on the acquisition of sustainability knowledge; thus, the role of ESD becomes certain. Since it "empowers people to change the way they think and work towards a sustainable future" (UN-ESCO, 2021). ESD gives prominence to the necessity of teaching students for examination, critical thinking, and the development of flexible and adaptive practices for implementations (Wiek et al., 2011). Accordingly, a large-scale

educational change is necessary to prepare a new generation of professionals to meet sustainability challenges through problem-solving methods that include systemic thinking and anticipation, value-added deliberation, evidence-based strategies, and strong collaboration among government, business, and civil society (Wiek et al., 2011). Therefore, sustainability programs in HEIs are responsible for preparing ground to convey these sustainability competencies and equip graduates in a way that they can contribute to resolving societal difficulties to achieve a sustainable future (Wiek et al., 2015).

On this account, the GreenMetric, in its last category in line with SDGs number 4, addresses the key role of ESD in fulfilling the green campus ambition by highlighting the significance of sustainability courses, research funding, publications, events, and student organizations along with the existence of sustainability reports and websites in universities; which is a significant factor in disseminating the latest sustainability knowledge, practices and experiences with community.

6. Conclusion

The GreenMetric fulfills the ambition of bonding sustainable development concept with strategies and implementations in HEIs, by emphasizing the application of sustainability initiatives in university dimensions, including education, research, operation, and outreach. The GreenMetric functions as a guide for university campuses, via its determined criteria and indicators based on SDGs, to be models for their society since university campuses resemble cities as they contain urban components on a smaller scale. Therefore, green campus initiatives include the sustainable management of buildings, landscape, energy, water, waste, transportation, and sustainable education. Accordingly, a green campus encompasses principles such as protecting the environment, lowering operating costs, and improving people's health and quality of life since the university campus is considered green in terms of its approach towards environmental, economic, and social dimensions. The green campus provides a ground

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for teaching, learning, examining, and experiencing sustainability matters and integrating the value-laden outcomes with the built environment, and eventually, exposing the host communities to the sustainability implementation methods to utilize them. Moreover, it encourages professionals to perform duties regarding sustainable development in a society; since sustainable development is a holistic approach, and all majors and fields should serve for its achievement.

In the GreenMetric perspective, a university campus is genuinely green if:

- Both natural and artificial green areas are protected and enhanced, as they are vital factors in moving toward sustainable development by providing environmental, social, and economic benefits.
- The elements of smart buildings and green buildings are implemented to reduce energy consumption.
- Renewable resources are used instead of nonrenewable ones.
- The greenhouse gas emission reduction program is devised to reduce carbon footprint, and consequently, to reduce global warming and reverse climate conditions.
- Sustainable waste management is considered because of the waste produced as a result of campus activities. Therefore, waste recycling programs are devised. Organic, inorganic, and toxic wastes are separated for treatment. Programs for reducing paper and plastics are implemented, and proper actions for sewage disposal or treatment are operated.
- Sustainable water management is considered; thus, water conservation and recycling programs are adapted, and treated water is consumed.
- Green transportation principles, such as traffic reduction program, parking management, promoting pedestrian and cyclist, promoting clean vehicles, and vehicle-free development, are considered.
- ESD is integrated into university education and research programs. Sustainability courses, events, and student-based organizations are devised and developed.

• An adequate budget is assigned for sustainability research, initiatives, and operations.

All these actions will alleviate the environmental impacts of university campuses and bring social and economic benefits. In sum, this study highlights sustainability initiatives' domains by using the GreenMetric as a framework and encourages HEIs to have a commitment to carrying out various sustainability efforts and changing their status to green campus, and consequently, function as driving forces for the broader community. However, continuous development and improvement of efforts are required to achieve the expected purpose of integrating sustainable development in HEIs.

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Restrictions interface proposal for the selection of sustainable stormwater management tools

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Abstract

In leading countries, alternative stormwater management (SWM) approaches guide design process with local guides, databases and user interfaces which are mostly land depended by their priorities and targets. Their adoption as a reference is challenging for designers in countries where sustainable stormwater infrastructure is undeveloped. This study presents a proposed interface for the selection of SWM tools according to site restrictions, hydrological functions, land use and performances based on location independent data.

SWM approaches, local guides and web-based resources are reviewed to form a dataset for common 26 SWM tools and their land-independent features to create a MS Office-based algorithm for designing an interface to help the user to define the suitable tool for the site. Interface is demonstrated as a design tool to create a water quality performance based storm-water treatment chain in ITU Ayazaga Campus. As a result, appropriate SWM tools are succesfully selected to convey runoff water from parking lots to storm-water pond considering the land use changes. And SWM tools were gathered from interface were suitable to create a chain. Also using the interface was time saving with no need for additional research on tools. Since the proposed interface promotes the integration of SWM into design decision making process in undeveloped countries and can be used as an education tool, it is expected to have a widespread impact.

Storm-water management, SWM tool selection interface, Location independent SWM tools, Storm-water treatment chain, ITU Ayazaga Campus.

1. Introduction

According to United Nations, % 55 of the current population of the world reside in urban areas and this number is expected to reach %68 by 2050 (United Nations,2018). This growing tendency of population in urban zones and urbanization process will have a growing threat on natural dynamics, resource availability and environmental quality (McGrane, 2016; EPA, 2021; Ahn et.al.,2005; Beach,2003; Brody,2007; Gaffield, 2003). Especially changing land cover from rural to urban which also means that change of the topography and surface conditions from permeable to impermeable as a result of new constructions, demolition and redevelopment have widespread impacts on dominant runoff-generating processes, and ket flow-paths, having a substantial impact on catchment boundaries and drainage pathways (McGrane, 2016).

On the other hand, the climate change causes significant impacts on the precipitation regimes over 25-100 years that will make urban design interventions releated to water systems more critical and complex (Ashley et. al 2005; Hill & Barnett, 2008; Hill, 2009). Therefore advancing our knowledge on urban hydrological process and its relation to spatial design urgently needs to be adressed in planning and design agenda. This situation necessitated reconsidering the relationship between urban areas and stormwater management, which urges reconstructing the urban spaces with stormwater management features and resilliency. Today, while some developed countries deal with stormwater management in urban areas with both legal and practical aspects, the issue is not sufficiently prioritized in developing countries that are traditional infrastructure-dependent. As experienced in urban areas, overwhelmed stormwater management systems can lead to localized flooding or greater runoff of contaminants which damages back urban habitat itself (EPA, 2021).

Beginning from the 1980s, changes in the urban drainage approach has shifted beyond focusing on the removal of stormwater from cities to consider it as a resource and evolved to adaption of approaches that guide design process with water management policies and implementation tools. According to Marsalek (2005), main reasons for these changes are (a) introduction of the sustainable development concept, (b) acceptance of the ecosystem approach to water resources management, (c) improved understanding of drainage impacts on receiving waters and (d) acceptance of the need to consider the components of urban drainage and wastewater systems in an integrated manner. The shift in the management of urban waters has led to the emergence of approaches that adopt sustainable stormwater management as an alternative to the existing conventional infrastructure. The terminology of the leading approaches differ according to the country of origin, as follows: LID (USA), WSUD (Australia), SUDS (Britain), LIUDD (New Zelland), Sponge City (China) (Radcliffe, 2019). These approaches consist of water management policies, resource control and water management tools (Marsalek, 2005), while their objectives and priorities vary according to the hydrological, infrastructural, ecological, planning issues of the site (Radcliffe, 2019). For instance, while the main focus of WSUD is developing infiltration techniques for different types of soils due to prevalent clay soil in many cities in Australia, LID concentrates on source control to protect natural characteristic of watersheds, and SUDS concerns water quantity, water quality and amenity issues for water control (Lanarc Consultants Ltd. et al, 2012). While local stormwater management guides and design interfaces prepared with reference to these approaches relate to a certain region, they include water management policies and tools specialised according to the sensitive ecology of that region. For example, while climate compatibility of SWM tools are used as a selection criterion in local guides of cold climate regions, it is observed that SWM tools and treatment chains to clean runoff water are prioritized in regions where mostly sensitive water sources or high ground water level are widespread.

Therefore, these similar approaches, which essentially derive from a common structure, may indicate contextual variations during their implementation stage.

Among this diversity, sustainable stormwater management, supported by relevant directives, interfaces, and online databases, has become an integral part of the design process in developed countries. However, differences in local water management policies, variety in terminology and SWM tools, and differentiated features according to guidelines create challenges for designers to use these approaches and guides as a reference in countries which are still dependent on traditional infrastructure and lack of sufficient data basis for sustainable stormwater management. In this regard, interfaces supported by location-independent data are required for the selection of SWM tools in countries that have not developed sustainable stormwater management yet.

In this study, a selection interface for SWM tools is presented which was developed as a part of a checklist proposal for sustainable water design in University Campuses. This selection interface tool was developed in two phases; 1- the first step includes creation of a database, which consist of sustainable SWM tools and their restriction features. The second phase includes development of an interface that transforms the selected restriction criteria to sustainable water management tools list with the help of an algorithm specifically prepared for this study. It is thought that this interface will help designers to integrate stormwater management into landscape design process, especially in countries like Turkey where urban water management system depends on traditional infrastructure.

2. Methodology

This research is structured around combined methods that include qualitative method for data gathering process and a case-study method to test the proposed SWM interface tool. In this context, the methodology of the research was proceeded in two phases. The first phase of the research includes definition of database. For this purpose, the secondary data were obtained from an in-depth literature review that includes stormwater management guidelines of LID, SUDS and WSUD (County, 1999; Ballard et al., 2007; Ballard et al., 2015; BMT WBM Pty Ltd, 2009; Transport

and Infrastructure Department of Planning, 2009), local sustainable stormwater design guidelines as; Maryland stormwater design manual, New York State stormwater management design manual, Vancouver Stormwater source control design guidelines, Saanich Stormwater management, Green stormwater infrastructure common design guidelines for The Capital Region, Low-impact development design strategies: An integrated design approach (Center for Watershed Protection, 2003; Center for Watershed Protection, 2000; Lanarc et al., 2012; Golder Associates Ltd., 2016; District of Saanich, 2020; Opus International Consultants Limited et al., 2019; County, 2014; Minnesota Stormwater Steering Committee, 2005; Bureau of Watershed Management, 2006, Center for Watershed Protection, 2015,) and additional resources for SWM Tools (Maryland Department of Environment, 2020; Lawson, 2005; Dyke et al., 2009; Fox. Et al., 2018; DeepRoot Green Infrastructure, 2014; Step,2011; Bray et al.2012; British Plastics Federation Group, 2018; Asadian and Weiler ,2009, Kumar et al, 2007). The data obtained from mentioned resources were classified and eliminated according to common SWM tools features included and an MS office-based algorithm was prepared to define the appropriate SWM tool.

For the second stage, the primary data were obtained from site visits which was conducted in 2020 to test the SWM selection interface tool on ITU Ayazağa Campus. Study area is chosen according to its diverse landscape character with dense built areas, natural areas and variable topography as a small prototype of a city. The Campus is also rated as the 71th in Green Metric 2020 ranking with its sustainable practices and management system in landscape. In this phase, hydrological, geological and topographic data of the area were collected, soil analysis, land use, land cover change, stormwater infrastructure analyzes were made and natural areas were determined. The obtained data were overlapped with the existing dimensional base map and the study area was divided into 88 micro-catchments considering hydrological features and landscape borders. In order

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to test the interface created in Stage 1, two adjacent micro-catchments, one with the connection to traditional infrastructure and provides stormwater transmission from an area of high construction rate to the second micro-catchment that includes protection area, were selected. With the results gathered from interface, a SWM tool chain with high water quality hydrological function is created between two micro-catchments.

2.1. Development of SWM tool selection interface

In the first step of the development of 'selection interface' for site restrictions of stormwater management; LID, SUDS and WSUD guides, sustainable stormwaterwater design local guides and additional resources as web based resources, thesis, book, reports were taken as a reference as stated above. Since the intention is to create a 'common pool' for the tools, these references were selected according to the SWM tools they include. The list of common tools in sustainable stormwater design and the list of restrictions, which are one of the selection criteria for these tools, have been gathered from the literature review. Afterwards, an MS Office-based algorithm was prepared, based on the obtained restrictions data and tool lists (Figure 1).

Within the scope of the study, the literature review carried out in two phases. In the first phase, determination of the water management tools has been done. Since the content of the local guides are prepared according to the local conditions of the region, variations in the SWM tools and the features they incorporate may differ from each other. For this reason, the list of tools obtained from the references was subjected to an elimination one more time, thus the list of common tools was obtained. The design variants and synonyms of the tools were determined through terminology research, and the final list of the sustainable tools that will generate the inputs to the algorithm, has been created (Figure 2). The list includes 26 tools namely; absorbent landscape, bioretention, cistern, conveyance swales, detention basins, dry well, filter trench, filter/buffer strip, flow-through rain planter, geocellular / modular systems, grass swale, green roof, infiltration basin, infiltration rain planter, infiltration trench, organic filter, perimeter sand filter, pervious pavement, stormwater ponds, rain barrel, rain garden, rainwater harvesting, stormwater wetlands, structural soil cell, surface sand filter, trees, underground sand filter, vegetated swale, wet swale.

The second phase of the literature review includes determination of the restriction categories. The content of the restrictions interface was determined by listing the common criteria in the selection matrices shaped under the titles such as restriction selection criteria in the reviewed guides. The selection criteria consist of 7 common criteria namely; hydrologic functions, slope restrictions, soil type, drainaige area, water table and land use. To determine the features of the tools for these criteria, websites with related databases and researches are also rewieved as well as approaches and local guides. The features to be used in the interface may vary according to the different resources. In this case, for the data selection of the features for interface, as a principle; the number of reference where the data has been published and the actuallity of these references were taken as a base. It is aimed to reveal the features of the tools which are independent of location.



Figure 1. Graphical abstract.



Figure 2. Methodology of research.

2.2. Restrictions interface design process

The interface, designed for the selection of SWM tools, contains a MS-Excel based algorithm and a suplemantary document named as 'Sustainable Stormwater Management Tools Design Criteria (SSDC)' which includes detailed information on the data in this interface and more features and of these tools as pretreatment needs. While this supplementary document contains all information of tools in detail, the algorithm functions as a practical interface for the selection of these tools. In this study, only the details and the working principle of the restrictions interface is presented.

The restrictions interface consists of 4 operation areas (Figure 3). First area, the 'Selection Table', contains sub-selection criteria specified for the main 6 restrictions types. The list of water management tools that are suitable for the selections made in the Selection Table in Area 1, appears in the 'Results Table' in Area 2. The 'Results Table, consisting of 6 columns, gives a list of tools that meet each criteria in separate columns. If some of the restrictions are not intended to engage in the algorithm, they are left in the 'Select' option and in the relevant column a list of all tools under the corresponding category (26) appear in Area 2. At the same time, in the 'Common

Results Table' in Area 3, the common tools from the 6 different SWM tools lists presented in Area 2 appear. Thus, while different tools are listed for each restriction criteria in the 'Results Table' (Area 2), the common tools that are suitable to all selection criteria are listed in the 'Common Results Table' (Area 3). This list (Area 3) indicates the appropriate stormwater design tools to be used by the designer in the project area. The table, 'Performances of Common Results', in Area 4 contains the performance summaries of the tools listed in the 'Common Results Table' in three categories: hydrologic function performances, water quality performances and hotspot restrictions. The 'Performances of Common Results', provides summary information, helps user to identify the tools among the Common Tools with the most appropriate performance for the design. The contents of the 4 areas forming the interface and their relations with each other are shown in Figure 4.

2.2.1. Selection table

It is the table where the user specifies the tool selection criteria according to the characteristics of the site and the stormwater management goals and also includes the subcategories of the 6 main selection criteria.

Hydrologic Functions; SWM tools have various hydrological functions such as interception, depression storage, infiltration, groundwater recharge, runoff volume, peak discharge, runoff frequency, water quality, base flow, stream quality (County, 1999). In literature research, only common performance data for interception, runoff volume reduction, peak discharge and water quality functions used in the interface could be reached. For this reason, only these 4 subcategories were provided as selection criteria for the hydrological function of the interface. Since there is a lack of data in the literature for performance assessment on interception, this function is presented with only 2 options, as 'Yes' or 'No', while runoff volume reduction, peak discharge, and water quality can be rated as 'high, medium, low'. The relevant ratings have been added to the option-

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Area 1				Are	ea 2			Area 3	Area 4			
				RESULS	S TABLE		,		PERFORMANCES OF COMMON RESULTS			
DESIGN RESTRICTIONS	SELECTION TABLE	Tools for Hydrologi Function Selection	c Tools for Slope Restriction	Tools for Soil Type	Tools for Drenaige Area	Tools for Water Table	Tools for Land Use	COMMON RESULTS TABLE	Hotspot Restrictions	Water Quality Peformance Summary	Hydrologic Function Performance Summary	
Iydrologic function	Select	Absorbent landscape	Absorbent landscape	Absorbent landscape	Absorbent landscape	Absorbent landscape	Absorbent landscape	Absorbent landscape	Recive directly from hotspot	NA	Interception- Runoff volume reduction (high)- Peak discharge (high)- Water quality (high)	
lope Restrictions	Select	Bioretentic	n Bioretention	Bioretention	Bioretention	Bioretention	Bioretention	Bioretention	Recive directly from hotspot	Heavy Metals (high) - Nutirents (low)- TSS (high)	Interception (high)- Runoff volume reduction (high)-Peak discharge (medium)- Water quality (high)	
ioil Type	Select	Cistern	Cistern	Cistern	Cistern	Cistern	Cistem	Cistern	Recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Runoff volume reduction (low)-Peak discharge (medium)- Water quality (low)	
Drenaige Area	Select	Conveyanc swales	Conveyance swales	Conveyance swales	Conveyance swales	Conveyance swales	Conveyance swales	Conveyance swales	Does not recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Interception- Runoff volume reduction (medium)- Peak discharge(medium) - Water quality(high)	
Vater table/ Bedrock	Select	Detention basins	Detention basins	Detention basins	Detention basins	Detention basins	Detention basins	Detention basins	Recive directly from hotspot	Heavy Metals (high) - Nutirents (medium)- TSS (high)	Interception - Runoff volume reduction (low)-Peak discharge (high)- Water quality (Medium)	
and use	Select	Dry Well	Dry Well	Dry Well	Dry Well	Dry Well	Dry Well	Dry Well	Does not receive directly from hotspot	Heavy Metals (high) - Nutirents (high)- TSS (high)	Runoff volume reduction (high)-Peak discharge (low)- Water quality (high)	
		Filter trenc	h Filter trench	Filter trench	Filter trench	Filter trench	Filter trench	Filter trench	Recive directly from hotspot	Nutirents (low/medium)- TSS (high)	reduction (low)-Peak discharge (medium) Water quality (high)	
		Filter/Buff	r Filter/Buffer strip	Filter/Buffer strip	Filter/Buffer strip	Filter/Buffer strip	Filter/Buffer strip	Filter/Buffer strip	from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (medium)	reduction (poor)-Peak discharge (low)- Water quality (medium)	
		How- through rai planter	through rain	through rain planter	through rain	through rain	through rain planter	Flow-through rain planter	receive directly from hotspot	(medium/high) - Nutirents (NA)- TSS (high)	merception (high)-Runoff volume reduction (high)-Peak discharge (medium)- Water quality (high)	
		Geocellula modular systems	/ Geocellular / modular systems	Geocellular / modular systems	Geocellular / modular systems	Geocellular / modular systems	Geoceflular / modular systems	Geocellular / modular systems	Does not receive directly from hotspot	Heavy Metals (none) - Nutirents (none)- TSS (high)	Runoff volume reduction (low)- Peak discharge (high)- Water quality (low)	
		Grass Swal	e Grass Swale	Grass Swale	Grass Swale	Grass Swale	Grass Swale	Grass Swale	Does not receive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Interception (medium) - Runoff volume reduction (medium)-Peak discharge (medium)- Water quality (high)	
		Green roof	Green roof	Green roof	Green roof	Green roof	Green roof	Green roof	Recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Interception - Runoff volume reduction (high)- Peak discharge (medium)- Water quality (high)	
		Infiltration basin	Infiltration basin	Infiltration basin	Infiltration basin	Infiltration basin	Infiltration basin	Infiltration basin	Does not receive directly from hotspot	Heavy Metals (high) - Nutirents (high)- TSS (high)	Interception - Runoff volume reduction (high)-Peak discharge (medium)- Water quality (high)	
		Infiltration rain plante	Infiltration rain planter	İnfiltration rain planter	İnfiltration rain planter	İnfiltration rain planter	Infiltration rain planter	İnfiltration rain planter	Does not receive directly from hotspot	Heavy Metals (medium/high) - Nutirents (NA)- TSS (high)	Interception (high) - Runoff volume reduction (high)-Peak discharge (medium)- Water quality (high)	
		Infiltration trench	Infiltration trench	Infiltration trench	Infiltration trench	Infiltration trench	Infiltration trench	İnfiltration trench	Does not receive directly from hotspot	Heavy Metals (high) - Nutirents (high)- TSS (high)	Runoff volume reduction (high)-Peak discharge (medium)- Water quality (high	
		Organic filter	Organic filter	Organic filter	Organic filter	Organic filter	Organic filter	Organic filter	Recive directly from hotspot	Heavy Metals (high) - Nutirents (medium)- TSS (high)	Runoff volume reduction (low)* Peak discharge (low)* Water quality (high)	
		Perimeter sand filter	Perimeter sand filter	Perimeter sand filter	Perimeter sand filter	Perimeter sand filter	Perimeter sand filter	Perimeter sand filter	Recive directly from hotspot	Heavy Metals (high) - Nutirents (low)- TSS (high)	Runoff volume reduction (poor)- Peak discharge (poor)- Water quality (high)	
		Pervious pavement	Pervious pavement	Pervious pavement	Pervious pavement	Pervious pavement	Pervious pavement	Pervious pavement	Recive directly from hotspot	Heavy Metals (high) - Nutirents (high)- TSS (high)	Interception - Runoff volume reduction (high)-Peak discharge (high)- Water quality (high)	
		Stormwate Ponds	Stormwater Ponds	Stormwater Ponds	Stormwater Ponds	Stormwater Ponds	Stormwater Ponds	Stormwater Ponds	Recive directly from hotspot	Heavy Metals (high) - Nutirents (medium)- TSS (high)	Runoff volume reduction (poor)-Peak discharge (high)-Water quality(high)	
		Rain barrel	Rain barrel	Rain barrel	Rain barrel	Rain barrel	Rain barrel	Rain barrel	Recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (medium)	Runoff volume reduction (low)-Peak discharge (medium)- Water quality (low)	
		Rain garde	n Rain garden	Rain garden	Rain garden	Rain garden	Rain garden	Rain garden	Recive directly from hotspot	Heavy Metals (high) - Nutirents (low)- TSS (high)	Interception- Runoff volume reduction (high)- Peak discharge (high)-Water quality (high)	
		Rainwater harvesting	Rainwater harvesting	Rainwater harvesting	Rainwater harvesting	Rainwater harvesting	Rainwater harvesting	Rainwater harvesting	Recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Interception - Runoff volume reduction (low)-Peak discharge (low)- Water quality (low)	
		Stormwate wetlands	Stormwater wetlands	Stormwater wetlands	Stormwater wetlands	Stormwater wetlands	Stormwater wetlands	Stormwater wetlands	Recive directly from hotspot	Heavy Metals (high) - Nutirents (medium)- TSS (high)	Runoff volume reduction (poor)- Peak discharge (high)- Water quality(high)	
		Structural soil cell	Structural soil cell	Structural soil cell	Structural soil cell	Structural soil cell	Structural soil cell	Structural soil cell	Does not receive directly from hotspot	Heavy Metals (high) - Nutirents (NA)- TSS (high)	Interception - Runoff volume reduction (high)Peak discharge (high)-Water quality (high)	
		Surface sar filter	d Surface sand filter	Surface sand filter	Surface sand filter	Surface sand filter	Surface sand filter	Surface sand filter	Recive directly from hotspot	Heavy Metals (high) - Nutirents (low) - TSS (high)	Runoff volume reduction (poor)- Peak discharge (poor)- Water quality (high)	
		Trees	Trees	Trees	Trees	Trees	Trees	Trees	NA	Heavy Metals (NA) - Nutirents (NA)- TSS (NA)	Interception(high) - Runoff volume reduction (medium)- Peak discharge- Water quality (medium)	
		Undergrou sand filter	d Underground sand filter	Underground sand filter	Underground sand filter	Underground sand filter	Underground sand filter	Underground sand filter	Recive directly from hotspot	Heavy Metals (high) - Nutirents (low)- TSS (high)	Runoff volume reduction (poor)- Peak discharge (poor)- Water quality (high)	
		Vegetated swale	Vegetated swale	Vegetated swale	Vegetated swale	Vegetated swale	Vegetated swale	Vegetated swale	Does not receive directly from hotspot	Heavy Metals (NA) - Nutirents (NA)- TSS (medium)	Interception- Runoff volume reduction (high)- Peak discharge (high)- Water quality (high)	
		Wet swale	Wet swale	Wet swale	Wet swale	Wet swale	Wet swale	Wet swale	Does not receive directly from hotspot	Heavy Metals (high) - Nutirents (low) - TSS (high)	Runoff volume reduction (low)- Peak discharge(medium) - Water quality(high)	

Figure 3. The areas that form the Design Restrictions Interface.

sets in the interface as obtained from the resources, and hydrological function performance with different ratings have been checked and clarified from different sources. The data considered poor in the relevant references is listed as low on the restriction selection list, and "Not available" data is entered into the algorithm for tools where hydrological function data are not available.

No data has been found whether the organic filter has an interception function or not, it has been added to the interface as 'Yes' as a result of the analyzed information.

Slope Restrictions; is the area where the maximum slopes for the relevant



Figure 4. Contents of the areas that form the interface and their relation with each other.

tools can be selected. The selection criteria are defined as flat, max. 4%, max.5%, max. 6%, max. 8%, max. 15%, max. 20%, max. 33% and not available.

The tools with a defined slope range appear not only on the maximum slope option to which they can be applied, but on all slope options they can be applied to. For example, a bioretention tool with a slope restriction max 6%, will appear for the following slope options; flat, max. 4%, max.5%, max 6%. For the tools that can be applied on slopes in a certain range, the slope ranges between the maximum and minimum values are determined and entered into the algorithm. Information for optimum, minimum or maximum slope for some tools were not available. These tools are classified as "not available" in the slope category, and since they do not have any restrictions on slope, they are included in the algorithm to appear in all slope options and as 'not available'. For instance, the cistern tool which has no restrictions on slope appears on all slope options and in the "not available", allowing the user to include it in the design. In order to avoid such situations from causing confusion about the maximum slope rate to which the relevant tools can be applied, all the data used in the algorithm related to the tools are included in 'SSDC' (such as Cistern slope restriction is not availabe).

Cistern, rain barrel, stormwater harvesting tools are specified as 'not available' to the algorithm.

Soil Type; The selection list, indicating the soil type in the area where the stormwater management practice will be applied, includes categorization of Hydrologic group A, Hydrologic group B, Hydrologic group C, Hydrologic group D and made soil. Made soil is determined for tools operates in offline system that require special soil (such as bioretention). Each practice has a soil type for optimal application while there are alternate soil types that the practice can be applied with modifications to the soil or with the practice itself. For example, many tools with infiltration capacity, preferably applied in A and B group soils, can also be applied to group C soils in sensitive areas by using a linear impermeable surface if groundwater is likely to be contaminated. In addition, there are cases where some tools suitable for application in A, B, C group soils can be applied in D group soils with soil modification. In the restrictions interface, the soil groups in which tools can be optimally used are added to the selection criteria, and their suitability in alternative soil groups are specified in 'SSDC'. In case of no restriction on soil type, A, B, C, D soil types are specified for the respective practice and if appropriate according to the type of practice (such as bioretention or pots), made soil is added.

Drainage Area; As a result of the literature review drainage areas where SWM tools can be applied are specified in 7 categories as max.4.000 m², max.8.000 m², max.15.000 m², max.20.000m², max.30.000 m², max. 40.000 m², min. 100.000m² and not available. Tools with larger drainage area appear in selections made for smaller drainage area. Since no clear data has been obtained about Pervious pavement and Structural soil cell, they are specified as "not available", and the principles for determining the drainage area of these tools have been provided in 'SSDC'.

Water table; Determines the minimum distance between the water table's seasonally highest level or from the upper water levels of the existing aquifers to the planned SWM tools. The criteria is particularly important in the management of waters with risk of pollution in sensitive areas, and in the use of infiltration tools to prevent contamination of groundwater. Based on the data in the references reviewed, the restriction options are defined as min.1.2 m, min.1 m., min.0,6 m., groundwater level and not available.

While all the tools specified as 'not available' appear on the selections over water table (min.1.2 m., min.1 m., min.0,6 m.), only the wet swale practice appears on the 'groundwater level' option. Cistern, Green roof, Rain barrel, Stormwater harvesting and Stormwater wetlands are the practice that are listed as 'not available' in the algorithm.

Land use; focuses on the development type of the project area as a limitation for the selection of the SWM tools. The selection criterias were grouped under 8 categories as residential, commercial/industrial, high density, contaminated sites, retrofit, parks and open spaces, local streets, parking lot. The criteria is important to protect sensitive sites. As in the contaminated sites

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stormwater can not be collected or infiltrated, tools like rainbarrel, dry well, infiltration trench are not preferred to be used. Also some tools are designed to be preferably applied to a unique area as rain planters are created to act like raingardens, bioswales, or infiltration tools in high density areas. And some practice's features may not be met with the development types; like ponds and stormwater wetlands are not suitable to be used in high density area due to the lack of available space and contamination risks. So, the criteria helps user to identify the best option that is suitable for the project area.

2.2.2. Performances of common results

The 'Performances of Common Results' table contains the performance summary of the tools in the 'Common Results Table' which is the last list the user will get in this interface. This table was created in order to support the user to identify the most suitable practice through an additional elimination in the last list according to their performance. The table consist of three information columns; summary information about the performances of water quality and hydrologic functions and practice's suitability for direct water intake from the hotspot are given.

Hydrologic function performans sum*mary*; if the practice that appears in the Common Results Table is known to have a hydrological function, however, any performance data is not available, only the name of relevant hydrologic function appears in this table without any rating. If the practice does not have the relevant hydrological function, the criteria is not included in the performance summary. While the performance ratings (high, medium, low) of all tools in the categories of runoff volume reduction, peak discharge and water quality are indicated in the table, the performance ratings of the in the interception category for the following ten tools could not be obtained; Absorbent landscape, detention basins, green roof, infiltration basin, pervious pavement, rain garden, stormwater harvesting, structural soil cell, vegetated swale.

Water quality performans summary; this column is added to the interface

to guide the user in choosing the most appropriate tools in order to create a treatment chain according to the water quality in the project area. The table that summarizes the water treatment performances of the tools for heavy metal, nutrients and TSS pollutants is presented in 5 categories as high, medium, low, none and not available. The indication of 'none' next to the component indicates that the related practice can not treat that component. The performance evaluation of some tools are obtained as ratings (high, medium or low), some are presented only through numerical performance values (such as nutrient removal capacity %50), and some have both rating and numerical performance values. In these cases, numerical data are evaluated by accepting EOR, 2004 performance ranges (removal rate (r.r.) >%60=high, %60>r.r>%40=medium, %40 r.r= low), and added to the algorithm. The references with both performance rating and numerical performance values, the given performance rating (high, medium or low) for the practice is selected as data for the algoritm.

In the examination of the references, TP, TN ve NO3 from the nutrients, and copper, lead and zinc among the heavy metals, were found to be the common components in the treatment performance table of the tools. For this reason, if no rated data about the Nutrients and Heavy metals treatment performance is obtained, the performance ratings are obtained by transforming the numerical percentage value of the specified constituent according to EOR, 2004 performance ranges and is added as the performance rating of the practice in the respective pollutant category in the interface.

In the table, the water quality performance of absorbent landscape and 'Nutrients' removal performance of flow-through rain planter and infiltration rain planter were specified as 'not available'.

Hotspot restrictions: the tools listed in the Common Results Table are grouped in three categories, as "receive directly from hotspot", "does not recieve directly from hotspot" and "not available". "Trees' is the only tool included in the algorithm as Not Available.

3. Case study: Restrictions interface usage

Technical Istanbul University Ayazaga Campus (Turkey) is located on an area of 247ha with both natural and built sites including 8 faculties, 4 institutes, rectorate and administrative buildings, student dormitories, a library, technopolis structures and student centers and a natural park(64ha) with stormwater pond (2ha). The campus is ranked as 71th in UI Green Metrics in 2020. As a part of green campus studies, all runoff water is aimed to be collected in the stormwater pond located in the campus. To promote this approach two parking lots (1928m2) located in the same micro basin with stormwater pond are selected as pilot area in order to demonstrate the restrictions interface by determination of suitable SWM Tools for runoff conveyance.

In order to understand the hydrological change of the study area due to construction, the site plans for the years 1970-2015 were compared and waterways before construction were determined from the satellite image of 1970 (Figure 5a). By overlapping the existing and disappearing water ways with the current topographic map, site plan and

rainwater infrastructure plan (Figure 5b), it is observed that most of the natural water ways before construction of the campus turned into vehicle roads and surface waters are transmitted by conventional infrastructure. Determining natural stormwater flow directions on built site topography and overlapping them with natural waterways revealed 3 different basin characteristics for the campus (Figure 5c) named as; regular basin (drained by transferring runoff water to neighboring basin), pit basin (unable to drain stormwater without conventional infrastructure) and stormwater-pond basin (draining runoff waters into stormwater pond). Following the hydrological, topographic, geological, soil, land use, infrastructure facilities and natural areas analyzes, the campus area was divided into 88 micro-catchments (Figure 5d). Different stormwater management strategies were determined for each basin and 2 microcatchments draining into the stormwater-pond basin were selected for the SWM Tool Selection Interface demonstration. One of the micro-catchments has natural features including a rainwater pond, and the other contains parking lots that transmit water from the built-up area to this



Figure 5. a) Natural waterways of ITU Ayazaga Campus in1970 (İstanbul Sehir Haritası, (n.d.) b) Overlapping dissepeared and existing waterways, with base map and stormwater infrastructure *c*) Basins with proposed rehabilitation waterways in ITU Ayazaga Campus *d*) Microbasins of ITU Ayazaga Campus.

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Figure 6. Project area in ITU Ayazaga Campus.

basin and contain potential pollutants. Since the amount of solids, metals, nutrients and organic pollutants exist in runoff water from parking lots is high (Revitt et al., 2014), the SWM Tools are expected to have water treatment effect, thus the primarily hydraulic function of the stormwater design is aimed to increase runoff water quality.

The parking lots designated as pilot areas are located on the vehicle roads surrounding the nature park where stormwater pond is located (Figure 6). Runoff water collected from the parking lots is aimed to be cleaned at the source with appropriate treatment methods, then conveyed to the beginning of the valley of stormwaterpond with pipes through the roads. Planned runoff water route includes different land use charasteristics as parking lots, vehicle road, pedestrian way and vegetated natural buffer zone of ITU stormwater pond which leads differentiation in appropriate SWM Tools determination. In this study, appropriate SWM Tool alternatives to convey water from source till stormwater pond will be searched by the restrictions interface and only the water conveyance through valley will be detailed.

Following the stage of collecting technical data and performing survey analysis, the SWM Tools determination process has been started. As a summary the analyze phase is as follows; sites natural waterflow ways are identified from the aerial photos of pre-construction period in 1970. The slope of the area was calculated from the dimensional drawing and base map overlap, and an appropriate water

conveyance route was determined by considering the topography, existing vegetation characteristics+layout and determined natural waterways. Runoff water collected from parking lots was decided to be transmitted in a route with a slope of 7.44%, which is divided into two parts, 6% and 8%, to promote usage of different SWM tools to create treatment chain for increasing the runoff water quality. The hydrological soil group of the study area had been accepted as HSC-C according to the ground survey reports in ITU Ayazaga Campus. Hydrological maps were examined to check groundwater existence for water table determination.

Restrictions Interface was tested as a design tool to list the most appropriate SWM tools for pilot area meeting design expectatitons with high hydrological performances in water quality, runoff water conveyance and creating treatment chain.

Following selection criteria were chosen according to pilot area's characteristics and the operation of the interface was presented step by step through the areas as defined in Figure 3. From the 'Selections Table' in Area 1, the selections were made according to the restrictions of the project area (Figure 7a). If any of the restrictions were unnecessary and not desired to make a selection for the project area, the relevant field was left as 'Select'. For ITU Ayazağa Campus example, there is no restriction for the water table characteristics so the criteria was left as the 'Select' option.

In the "Results Table" in Area 2, a list of tools that meet the selection criteria
applied in the previous step do appear. In this area, since the tools that meet each criteria are listed in different columns, the user has the chance to observe the changes in the tools that meet that criteria by changing the selection criteria. In this example, all 26 tools appeared in the 'Results Table' for water table, which is not considered as a restriction and similarly for drainage area as all tools meet the specified selection criteria (Figure 7b).

In the 'Common Results Table' in Area 3, the common tools from 6 different columns in the Results Table (Area 2) are listed. Thus, a list of 4 SWM tools that meet all the criteria in the Selection Table (Area 1) is obtained (Figure 7c). In the 'Performances of Common Results' table in Area 4, performance summaries for resulting four SWM tools are indicated. In the Hydrologic Function Performance Summary column, no rating for 'interception' for the green roof and vegetated swale states that this practice provides interception but its performance raiting is not defined. The absence of 'interception' in the Hydrologic Function Performance Summary presented for the stormwater ponds and stormwater wetlands means that these practices do not have interception features.

While four SWM Tools appeared in the Common Results List are compatible with the demands of the pilot area, vegetated swale is the only option that

Are	a 1
DESIGN RESTRICTIONS	SELECTION TABLE
Hydrologic Function	Water quality (high)
Slope Restrictions	Max. 8%
Soil Type	Hydrologic group C
Drenaige Area	Max. 4.000 m2
Water table/ Bedrock	Select
Land use	Parks - Open spaces

)(Area 2							
	Tools for Hydrolog Functions Selectio	ric n Tools for Slope Restr	riction Tools for Soil Typ	e Tools for Drenaige Area	Tools for Water Table	Tools for Land Use			
	Absorbent landscape	Absorbent landscape	Cistem	Absorbent landscape	Absorbent landscape	Absorbent landscape			
	Bioretention	Cistem	Conveyance swales	Bioretention	Bioretention	Bioretention			
	Conveyance swales	Conveyance swales Geocellular / modular	Detention basins	Cistem	Cistem	Conveyance swales			
	Filter trench	systems	Filter/Buffer strip	Detention basins	Detention basins	Dry Well			
	Flow-through rain plant	er Green roof	Flow-through rain plant Geocellular / modular	er Dry Well	Dry Well	Filter trench			
	Grass Swale	Infiltration basin	systems	Filter trench	Filter trench	Filter/Buffer strip			
	Green roof	Infiltration trench	Green roof	Filter/Buffer strip	Filter/Buffer strip	Flow-through rain planter Geocellular / modular			
	Infiltration basin	Stormwater Ponds	Organic filter	Flow-through rain planter Geocellular / modular	Flow-through rain planter Geocellular / modular	systems			
	Infiltration rain planter	Rain barrel	Perimeter sand filter	systems	systems	Grass Swale			
	İnfiltration trench	Rainwater harvesting	Pervious pavement	Grass Swale	Grass Swale	Green roof			
	Organic filter	Stormwater wetlands	Stormwater Ponds	Green roof	Green roof	Infiltration basin			
	Perimeter sand filter	Trees	Rain barrel	Infiltration basin	Infiltration basin	Infiltration rain planter			
	Pervious pavement	Vegetated swale	Rain garden	Infiltration rain planter	Infiltration rain planter	Infiltration trench			
	Stormwater Ponds		Rainwater harvesting	İnfiltration trench	Infiltration trench	Organic filter			
	Rain garden		Stormwater wetlands	Organic filter	Organic filter	Perimeter sand filter			
	Rainwater harvesting		Structural soil cell	Perimeter sand filter	Perimeter sand filter	Pervious pavement			
	Stormwater wetlands		Surface sand filter	Pervious pavement	Pervious pavement	Stormwater Ponds			
	Structural soil cell		Trees	Stormwater Ponds	Stormwater Ponds	Rain garden			
	Surface sand filter		Underground sand filter	Rain barrel	Rain barrel	Rainwater harvesting			
	Trees		Vegetated swale	Rain garden	Rain garden	Stormwater wetlands			
	Vegetated swale			Stormwater wetlands	Stormwater wetlands	Trees			
	Wet swale			Structural soil cell	Structural soil cell	Underground sand filter			
				Surface sand filter	Surface sand filter	Vegetated swale			
				Underground sand filter	Underground sand filter				
				Vegetated swale	Vegetated swale				
Į				Wet swale	Wet swale				
))	Area 3		Area 4						
	COMMON RESULTS TABLE	Hotspot Restrictions	PERFORMANCES OF Water Quality Peformance Summary	COMMON RESULTS Hydrologic Function Perfor	rmance Summary				
	Green roof	Recive directly from He hotspot N	eavy Metals (medium) - atirents (low)- TSS (high)	Interception - Runoff volume redu discharge (medium)- Water quality	ction (high)- Peak (high)				
		Recive directly from H	eavy Metals (high) - Nutirents	Runoff volume reduction (poor)-P	eak discharge (high)-				

Figure 7. a) Main selection table of the interface b) Results table for the selection criteria c) Common Results Table and Performance Summaries of the interface.

Runoff volume reduction (poor)- Peak discharge (hi Water quality(high) Interception- Runoff volume reduction (high)- Peak discharge (high)- Water quality (high)

ion (poor)- Peak discharge (high)-

Restrictions interface proposal for the selection of sustainable stormwater management tools

can be used for runoff water conveyance criteria from the list. In the performance table of common results, it is proved that this tool also promotes water quality with high performance in heavy metals and TSS and low/medium in nutrients. Since the runoff water from parking lot is not considered as a hotspot, vegetated swale can be considered as suitable for the pilot area. Proposed interface helped to eliminate wet swale and dry swale options due to slope restrictions which is max %4 for these SWM tools. Only wet swale can ben considered as an alternative for end of the vegetated swale where it is connected to pond and wet ground can be achieved by terrain gradiation.

In order to increase the quality of the runoff water before entering the stormwater pond, the SWM tool to be located after the vegetated swale is searched with the following criteria by restrictions interface. Since the runoff water collected from the parking lot was not highly contaminated, the selection phase was carried out in two stages as hydrological function with medium water quality (Sekil8a) and high water quality (Sekil 9a), to reveal the alternative SWM tools (Figure 8b, Figure 9b). Additionally, the suitability SWM tools for natural buffer zone was also checked due less intervention to field is required and filter buffer strip was deemed to be the most appropriate tool among the results obtained (Figure 8b, Figure 9b). Considering the pilot area's priorities, results of selection in Figure 8b also reveals to be more appropriate to be implemented close to parking lots far from the buffer zone.

From the selections above, a runoff treatment and conveyance chain for the nature park zone has been created (Figure 10a). The vegetated swale is supported with forebay as an additional pretreatment process, so the high water quality is guarantied. Considering runoff management requirements in parking lots, selections with the Restrictions Interface has carried out and high performance based runoff treatment chain for all demonstration area was suggested as Figure 10b.

Stromwater design implementation shows that the usage of Restrictions Tool let the designer directly choose

Are	a 1
DESIGN RESTRICTIONS	SELECTION TABLE
Hydrologic Function	Water quality (medium)
Slope Restrictions	Max. 6%
Soil Type	Hydrologic group C
Drenaige Area	Max. 4.000 m2
Water table/ Bedrock	Select
Land use	Parking lot
Area 3	

a

b

۱.	Area 3	Area 4					
1			PERFORMANCES OF	COMMON RESULTS			
	COMMON RESULTS TABLE	Hotspot Restrictions	Water Quality Peformance Summary	Hydrologic Function Performance Summary			
	Filter/Buffer strip	Does not receive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (medium)	Interception (high) - Runoff volume reduction (poor)-Peak discharge (low)- Water quality (medium)			

Figure 8. a) Selection phase of Interface for parking lots b)SWM Tool Results of Interface for parking lots.

	Area 1			
DESIGN RESTRIC	TIONS SELECTION	TABLE		
Hydrologic Function	Water quality (h	igh)		
Slope Restrictions	Max. 6%			
Soil Type	Hydrologic group	с		
Drenaige Area	Max. 4.000 m2			
Water table/ Bedrock	Select			
Land use	Parks - Open space	es		
Area 3	Area 4			
0010101		PERFORMANCES OF	COMMON RESULTS	
RESULTS TABLE	Hotspot Restrictions	Water Quality Peformance Summary	Hydrologic Function Performance Summary	
Green roof	Recive directly from hotspot	Heavy Metals (medium) - Nutirents (low)- TSS (high)	Interception - Runoff volume reduction (high)- Peak discharge (medium)- Water quality (high)	
i	Deserve in Parala	Hanny Matale (high) Muticante	Land the strength of the strength os strength of the strength os strength os strength os strength os strength os strength os strength os strength os strength os strength os strength os strength os strength os strength os s	
Infiltration trench	from hotspot	(high)- TSS (high)	Peak discharge (medium)- Water quality (high)	
Infiltration trench Organic filter	from hotspot Recive directly from hotspot	(high) - TSS (high) Heavy Metals (high) - Nutirents (medium)- TSS (high)	merception(medium)-Runoi volume reduction (mgj)- Peak discharge (medium)- Water quality (high) Runoff volume reduction (low)- Peak discharge (low)- Water quality (high)	
Infiltration trench Organic filter Perimeter sand filter	from hotspot Recive directly from hotspot Recive directly from hotspot	(high) - TSS (high) Heavy Metals (high) - Nutirents (medium)- TSS (high) Heavy Metals (high) - Nutirents (low)- TSS (high)	Interception(medium)-kunoff volume reduction (mgn)- Peak discharge (medium)-Water quality (high) Runoff volume reduction (low)- Peak discharge (low)- Water quality (high) Ruter quality (high)	
Infiltration trench Organic filter Perimeter sand filter Stormwater Ponds	Recive directly from hotspot Recive directly from hotspot Recive directly from hotspot Recive directly from hotspot	(high) - TSS (high) Heavy Metals (high) - Nutirents (medium)- TSS (high) Heavy Metals (high) - Nutirents (low)- TSS (high) Heavy Metals (high) - Nutirents (medium)- TSS (high)	interception[mectual]. Peak discharge (medium). Water quality (high) Rumoff volume reduction (low)- Peak discharge (low)- Water quality (high) Rumoff volume reduction (poor)- Peak discharge (poor) Water quality (high) Rumoff volume reduction (poor)-Peak discharge (high)- Water quality (high)	

Figure 9. a) Selection phase of Interface for natural park b) SWM Tool Results of Interface for natural park.



Figure 10. a) Proposed runoff conveyance and treatment chain for ITU natural park b) Proposed runoff conveyance and treatment chain form parking lots to ITU stormwater pond.

the appropriate SWM Tools which is most suitable for the project area considereing the local characteristics of the site and the results can be implemented to the landscape design field in order to save time.

4. Conclusion

Within the scope of the study, a common database for SWM tools had been created by taking into consideration the sustainable stormwater management approaches adopted in Australia, USA, Canada, and the local stormwater management design guides derived from these approaches. The SWM tools database is created with the intention to be location-independent as the selection of the tools for inclusion is based on their presence in at least 2 resources which are suitable for different climates. The algorithm, which was developed with reference to the practice selection matrices of the relevant approaches and guides, offers designer a list of tools suitable for the project area, as well as feedback on the performance summaries and the features of the tools. Since the selection and results tables are operated and presented progressively, the interface informs the user about the features of the tools, so the usage of proposed interface is considered as a selection tool as well as an educational tool. Interface's introductory feature of the SWM tools will help the students to learn actively during the application phase.

The interface, created with the transformation of the scattered data in the references into an algorithm, qualifies as a tool that the user can integrate sustainable stormwater management into the landscape design process. The interface considers the restriction features of the project area such as soil condition, drainage area, groundwater table, and slope, also performs elimination on the tools according to aimed hydrological functions and site uses. Thus, users can obtain the most suitable stormwater design tools for the project area by entering the data obtained during the analyzes phase of the project. The tools listed in the Common Results Table have different hydrological features such as filtration, source control, infiltration, treatment, enhanced physical properties and variety of benefits (such as biodiversity, carbon capture, heat island effect) offer alternative spatial solutions for the project area. This situation shows the impact of the proposed interface on the space formation during the decision process of urban water management and urban space design.

In this study, the interface is used to select the appropriate SWM Tools for parking lots located in basin of the stormwater-pond of ITU Ayazaga Campus. Considering that the runoff water collected in the stormwater-pond will be reused for campus irrigation, it is important that the conveying stormwater reaches the pond with high quality. For this purpose, within the scope of this study SWM Tools with treatment quailities are aimed and the interface is used to determine the most appropriate ones among 26 SWM tools, considering the constraints revealed in the analyses phase. The use of the interface in the design process allowed the evaluation of all spatial data obtained during the analysis phase. Content of Common Results Table let the designer to prewiew performances for the hydrological functions, thus results in high performance-based stormwater design in landscapes with simple and time saving tool. Also, the fact that design constraints are included in the interface as selection criteria has ensured that these constraints are taken into account during the design phase which is crucial while dealing with natural lands and water management.

During the creation of a database for structural and non-structural tools, conflicts and confusions related to the terminology of the tools in literature were observed. Considering that sustainable stormwater control methods and tools are recommended under the leadership of developed countries and referenced by designers in countries that do not have that type of infrastructure, there is a need to establish a 'common water management tools terminology' with international validity, without being affected by the different approaches or geographical differences. Additional researches regarding the performance of the absorbent landscape / trees, which is an effective unstructural practice in the creation of sustainable landscapes, is needed.

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Although the cost-effective criteria are commonly seen in the selection matrices of the reviewed references, it could not be added to the restrictions interface due to the differences like material and currency. In order to evaluate the financial constraints of water management tools at the selection stage, it is necessary to conduct a unit price analysis of the tools on local scale.

For Turkey and similar countries, since they have different geographical, hydrological, climatic, socio-cultural and urban development featured regions, it is recommended to create water management guides that consider the regional differences and support these guides with the following studies; 1sharing the necessary local data through open web-based platforms to be used during the sustainable water design analysis phase; 2- Considering climate diversity, observation of the hydrological performance and durability of the tools in different climate scenarios and recommending alternative adaptable tools in regional level if necessary. At the same time, it is recommended to develop similar databases in different climate scenarios and open it to international use in order to be used by designers in regions that lack sustainable drainage infrastructure.

The study creates a common pool for the SWM Tools that is appropriate to be used anywhere. Since SWM tool selection interfaces in developed countries contain local SWM tool names and ready-made information such as local precipitation and soil, their use is limited outside the borders they are prepared for. The difference of the proposed interface from the existing ones is, that it contains more SWM Tools. As LID focuses on source control tools, WSUD concentrates on infiltration tools, the proposed interface includes all these SWM tools. Also 57 different SWM Tools obtained from the literature study is filtrered (terminology and common features) and reduced to 26 common SWM Tools with land independent features to be appropriate to be used anywhere.

The interface prepared will contribute to two areas;

• The proposed interface is a practical tool that can be part of the design process in the field of Urban Design

and Landscape Design. SWM tools, obtained according to prior hydrological function and determined by data entry of the appropriate site features, will help designers to develop solutions with the most effective results for storm water management. As the interface can be used by the designers in production phase, public institutions will also benefit in the control process of the suitability of the project.

Students can use the proposed in-• terface on SWM-specific topics as an educational tool. In planning and design education, it can be used as a practical educational tool for students to see the results of their decisions regarding the relationship between water and design, to compare different design decisions, and to develop spatial design decisions for water management with site-specific data. In this way, water and design awareness can be brought to students at the undergraduate level in practice.

For future research, performances of 26 SWM tools in benefits as biodiversity, carbon capture, heat island effect can be evaluated, and results can be used as another data entry to form a base to argue the sustainability of the projects in all aspects.

This study is considered to have a widespread impact since it can be used in other countries similar to Turkey, which are lack of sustainable stormwater design guides and do not have sufficient performance studies to support these alternative infrastructures. It can also be a basis for the development of SWM guidelines in these developing countries.

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Biophilic dimensions of products and their effects on user preferences

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Abstract

Biophilia is hypothesized as one of the defining concepts guiding human preferences of everyday life. Although "biophilia" has been well integrated as a design approach in Architectural and Urban Design, it is yet to develop in industrial design. Employing a two-staged approach, we aimed to define the biophilic characteristics of a product multidimensionally and examine their effects on the users' preferences.

The first stage consisted of empirical studies to describe the biophilic dimensions. This endeavor yielded a word set (N=78) that qualifies the biophilic dimensions (N=6). The words obtained consisted of biophilic design values and the hypothetical biophilic product dimensions that were proposed by researchers. Also, we obtained a set of product images (N=18) to be used throughout the study.

The second stage was designed to explore the effects of biophilia on user preferences. An expert group (N=120) assessed the associations between the words and product sets. Also, a user group (N=1.206) rated how much they preferred these products. The data obtained from the experts and the users were analyzed to examine how the biophilic dimensions predicted the user preferences by regression analyses conducted on SPSS 27. The results revealed that the functional dimension has a significant effect on user preferences in both biophilic and non-biophilic/biophobic cases while the psychological dimension has a significantly negative effect on user preferences just in non-biophilic/biophobic cases.

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Biophilia, Biophilic design, Biophilic dimensions of products, User product preferences, Industrial design.

1. Introduction

For industrial designers, it is often imperative to understand the effects of products on user preferences and the underlying psychological mechanisms. The biophilic quality of a product may be proposedly one of the qualities that can affect the users' decision mechanism. It is fair to say that it is virtually impossible to understand the effects of the biophilic quality of products on user preferences without defining their biophilic characteristics. However, to the best of our knowledge, there is neither an empirical effort to define the biophilic characters of products nor their effects on the user preferences up to date. Therefore, the questions addressed in this study were "What are the dimensions of a product that characterize its biophilic quality?", and "How do the biophilic dimensions of products affect user preferences?"

Although the concept of biophilia sometimes evokes a psychological disorder (e.g. opposite of necrophilia), as Wilson (1984) stated, biophilia in the most general sense refers to a healthy state in that it corresponds to an innate love of life and nature. Biophilia is a phenomenon that innately acts on the physiological and psychological well-being of humans. A body of studies shows that interaction with nature has a significant role in decreasing blood pressure, illness symptoms, and stress-related disorders (Kellert & Calabrese, 2015). Taking a walk through woods or watching across the sea-side, even to look at a depiction of a natural view, have positive effects on human well-being (Kellert, 2005). Nature dependency is wired in our brain and body (Heerwagen & Hase, 2001) and that essential yet implicit phenomenon, biophilia, is worth calling forth to dig its effects and benefits up in a more detailed way. Yet biophilia is also an essential factor in people's decision mechanism regarding spatial preferences in particular, as the evolutionary hypotheses of sheltering predict.

From the perspective of biophilia, the interaction of humans with the environment and how this interaction reflects on people's life choices have long attracted the attention of researchers. In the fields of Architecture and Urban Planning, biophilic designs often reflect the history of people's interactions with their physical environment. Jay Appleton (1975) proposed Prospect & Refuge Theory as a need to hide from dangers in a proper location where one can observe the possible attack. In his seminal Savanna Hypothesis, ecologist Gordon Orians (1980) argued that our current preferences for the environment were inherited from our ancestors, which led us to explore vital resources but avoid hazards. He maintained that as a species that had evolved in a natural, even wild environment, humans are still searching for those natural features in their modern environment. Orians and psychologist Judith Heergaven (1992) expanded it by proposing the Habitat Selection Hypothesis predicting that the tendencies to the tropic African savanna-like features such as the trees and canopies providing open views and hidden positions from dangers, landscapes rich in food resources, hunting possibilities, and water resources, and also the complexity of the intriguingly rich spaces, yet not too complicated are still influential on the modern life preferences of humans (Orians & Heerwagen, 1992).

Biophilic preferences are therefore functional, and selection has likely fashioned preferences of ancestral humans in favor of assessment of biophilic features more positively. Consistent with this analysis, proposed by Rachel and Stephen Kaplan (1989), the Attention Restoration Theory stated that nature's complex and ordered structure passively caught the human's attention. In other words, our attentional system has evolved to be sensitive to biophilic features which are presumably adaptive for survival and reproduction. Thus, the theory provided an implicit but strong connection between the human mind and nature (Kaplan & Kaplan, 1989).

Probably, fractality is the most essential physical structure of nature and life. As Salingaros (2015) asserted, natural entities have a complex fractal structure rather than simply linear, perpendicular, or planar one, and humans as entities constituted by fractal structure themselves, are prone to detect and bond with the natural fractals. Many modern human-built structures that lack fractal organization, or are non-biophilic, have no competency either to have a healthy relationship with humans or to engage their attention (Salingaros, 2015; Salingaros & Masden II, 2008).

Ostensibly, all theories above also include avoiding the hazards of the natural environment, which is called "biophobia". Kellert (1997) articulated biophobia as "Human fascination for natural diversity is a two-edged sword-one side enriching and inspiring; the other, the source of great dread and disdain.". He also emphasized its evolutionary significance for survival, and the guiding role in avoiding the ominous sides of nature, which could cause dangerous consequences (Kellert, 1993). The dangers in nature require substantial attention and energy.

Another related concept, 'non-biophilia', expresses the non-presence of nature besides the dichotomy of biophilia and biophobia (Gochman, n.d.). Gochman, (n.d.) describes the non-biophilic sites as "loud, smoky, barren, or non-restorative" in the scale of the city. Non-biophilia is also the opposite of biophilia, but it doesn't belong to nature or the biological world as biophobia does. It may indicate the human-built things which do not even recall the natural or biophilic principles.

Although they hold different perspectives in their theoretical analyses, all theorists agree on the restorative effects of nature on people's physical and mental health. Exposure to nature improves well-being by reducing stress, blood pressure, muscle tension, heart rate, and anxiety, and by increasing dopamine levels, immune functions, attentional vigilance, sense of serenity, mood, and physical and mental performance. (See also Arvay, 2015/2018; Browning et al., 2014; Kaplan & Kaplan, 1998; Kellert, 2005, 2008; Kellert & Calabrese, 2015; Ryan et al., 2014; Salingaros, 2015; Salingaros & Masden II, 2008; Ulrich, 2008; Wilson, 2008).

In cases, humans have no direct contact with nature (e.g. hiking or camping in the forest, swimming in the sea), we can still speak of biophilia as indirect contact (e.g. potted plant, manicured lawn) and symbolic contact (e.g. visual depictions in paintings and photographs, nature metaphors in stories and myths) (Kellert, 2005); and the restorative effects of the indirect and symbolic contacts with nature as well (Ulrich, 2008).

Biophilic design seeks the essence of the natural features which are beneficial for humans. Consequently, the biophilic approach in the built environment is of prime concern considering the lack of natural attributes of today's environment. Joye (2007) argued that the restorative effects of nature might have originated in the fractal structure and patterns that all-natural entities have rather than natural scenery. He emphasized the importance of considering the biophilic approach as a multidisciplinary study, including the psychological and cultural aspects together with the fractal structure (Joye, 2007). Indeed, the convergence of physical and social elements is one of the most prominent topics in the literature on biophilia.

An increase in the awareness of the discovered effects of biophilia on personal well-being and the need for more natural features in the artificial environment led the designers to create spaces with direct natural items or features referring to savanna. Besides the human-centered and restorative approach of biophilic design, as Ryan stated in the introduction of Salingaros's (2015) work, biophilic features are used to design places like offices, schools, healthcare facilities, airports, manufacturing facilities to improve efficiency. Similarly, Heerwagen (2003) pointed out that people tended to go to the shopping malls or department stores more where the retail settings are manipulated by employing savanna-like features. Even though the examples above illustrate the commercial use of biophilic features and are out of the scope of this research, it is significant to see the impact of the biophilic approach.

A body of work has been done in biophilic architecture and urban design to specify the basics, categories, and qualities. Architectural and urban design often employs biophilic approaches regarding direct spatial relation with the concept of biophilia. However, product design remains out of the literature on biophilia even though the products are significant parts of the built environment. This paper is based on research to frame the product-specific biophilic dimensions to develop a definition for biophilic products and search for the effects of those dimensions on users' product preferences.

2. Method

The cognitive representations of products are important for individuals concerning the adaptations to their environment. On the other hand, those cognitive representations occur through a set of dimensions that categorize the product qualities rather than as an arbitrary criterion. The sets of product value are mostly proposed based on an intersection of physical and social dimensions (Boztepe, 2007; Frondizi, 1971; Holbrook, 1999) more or less as Boradkar (2010) suggested "symbolic, emotional, historical, cultural, aesthetic, social, political, environmental, utilitarian, economic, and brand value". To obtain a comprehensive list, we employed both physical and social categories spanning seven dimensions including form, function, material, sensorial, attitude, semantic, and psychological dimensions. Those dimensions are often taken as criteria when the potential to reflect a biophilic character in the field of design is evaluated. Within this research, the economic dimension is excluded due to focusing on preferences of use rather than affordability. Since there is no definition of product-specific biophilic characteristics in literature; starting with common dimensions enabling a deeper and detailed approach would provide a multidimensional perspective to the study rather than a binary evaluation like tagging a product as biophilic or not. The hypothetical definition of a biophilic product with its common dimensions and possible qualities is demonstrated in Table 1.

The research consists of two stages. The first stage aims to define the biophilic product among its dimensions, and the second stage searches for the effects of those biophilic dimensions on users' product preferences. The first stage covers a set of empirical studies that are 1st and 2nd user group studies, and 1st and

Table 1. Biophilic product dimensions and proposed qualities as a basis.

	form	function	material	sensory
	(a)symmetry	energy saving	healthy	color
	curve	productivity	natural	odor
ions	contrast	comfort	safe	sound
mens	fractal geometry	ergonomy		taste
ical di	rhythm			texture
Physi	clear vision			vibration
	coherency with the function			
	balance			
	organic / amorphous			
	attitude	psychological	sem antic	
	active	consistency	connotations	
	ecological	emotions	iconic value	
su	familiarity	feelings	symbolic value	
ıensic	healthy	safety	historical / story	
al din	honesty	wellbeing		
Soci	loyalty (domestication)	calmness		
	identifiability			
	integrating the user			
	coherency (environment relationship)			
1 ^s in-depti	t User Group Study h interviews with 4 participants		3 rd Expert Group Study surveys with 120 participants	
1 st structur	Expert Group Study red interviews with 40 participants		3 rd User Group Study surveys with 1.206 participants	
2 ⁿ	^d User Group Study urveys with 29 participants		Reliability Tests	
2 nd expe	Expert Group Study rt review with 15 academicians	L	inear Multiple Regression Analysis	n
Biophilic pro	STAGE I oduct definition among the biophili	c The effe	STAGE II cts of biophilic dimensions of p	roducts

Figure 1. Method scheme.

2nd expert group studies, to define the dimensions of a biophilic product. The second stage includes the 3rd expert and user group studies, reliability tests, and linear multiple regression analysis to understand the user preferences regarding the biophilic dimensions.

2.1. Stage I: Biophilic product definition among the biophilic dimensions of products

In stage I, the research is designed to define the biophilic product with its dimensions to be used for the user preferences search. First, in-depth interviews were held with 4 participants (1st user group) as a pilot study to determine the product images that would

Table 2. Elements and attributes of biophilic design (Kellert, 2008, p.15).

		Elements and Attrib	outes of Biophilic Design		
Environmental features	Natural shapes and forms	Natural patterns and processes	Light and space	Place-based relationships	Evolved human-nature relationships
Color	Botanical motifs	Sensory variability	Natural light	Geographic connection to place	Prospect and refuge
Water	Tree and columnar supports	Information richness	Filtered and diffused light	Historic connection to place	Order and complexity
Air	Animals (mainly vertebrate) motifs	Age, change and the patina of time	Light and shadow	Ecological connection to place	Curiosity and enticement
Sunlight	Shells and spirals	Growth and efflorescence	Reflected light	Cultural connection to place	Change and metamorphosis
Plants	Egg, oval and tubular forms	Central focal point	Light pools	Indigenous materials	Security and protection
Animals	Arches, vaults, domes	Patterned wholes	Warm light	Landscape orientation	Mastery and control
Natural materials	Shapes resisting straight lines and right angles	Bounded spaces	Light as shape and from	Landscape features that define building form	Affection and attachment
Views and vistas	Simulation of natural features	Transitional spaces	Spaciousness	Landscape ecology	Attraction and beauty
Façade greening	Biomorphy	Linked series and chains	Spatial variability	Integration of culture and ecology	Exploration and discovery
Geology and landscape	Geomorphology	Integration of parts to wholes	Space as shape and form	Spirit of place	Information and cognition
Habitats and ecosystems	Biomimicry	Complementary contrasts	Spatial harmony	Avoiding placelessness	Fear and awe
Fire		Dynamic balance and tension	Inside-outside spaces		Reverence and spirituality
		Fractals			
		Hierarchically organized ratios and scales			

be used during the research and to structure the interviews with the user groups. In this pilot study, over 200 product images were displayed to the users on a monitor and after the first view, they were asked to review the images considering the following criteria:

- familiarity,
- convenience to be recognized regarding the form and function,
- use frequency in daily life.

A set of product images consisting of 95 products were chosen by the criteria that the participants put above and balanced by the researcher by considering the following:

- having physical or abstract references to living or natural beings,
- being made of natural or artificial materials,
- connotation to status and prestige,
- same/similar products demonstrated in different backgrounds (natural or artificial surroundings),
- same kind of products used in different contexts (different shooting angles or set-ups),
- same or similar products with different colors and patterns,
- Scandinavian designs that have both modern and organic forms,
- having functional prominence,
- necessitating interaction with the user, user's active involvement.

The product image set includes armatures, cutlery sets, salt and pepper containers, sieves, lemon squeezers, grinders, and seating units as generic products can be easily recognized and comprehended.

The evaluations of the products regarding biophilic characteristics, dimensions, and values were done through a group of words throughout the study. To put those words out, a set of interviews were held with an expert group of 40 academicians and/ or professional designers (1st expert group) 24 female and 16 male members constituted the group, and 31 were academics, while 9 were professionals. Participants had at least one degree of higher education (undergraduate or postgraduate) in Industrial Design with an average of 14 years of experience. The academicians were employed in the departments of Industrial Design as research assistants, instructors, assistant and associate professors, and professors in various universities. The professional designers had working experience of between 7 and 30 years.

The 1st expert group was asked to generate words, adjectives, phrases, expressions, etc. related to the concepts of 'biophilic', 'non-biophilic', and 'biophobic' by brainstorming through free association. Also, the participants evaluated the 95 products as biophilic, non-biophilic, biophobic, or none. At the end of this phase, we obtained a word set, consisting of 2,238 words, adjectives, and phrases in total; associated with the qualifier of biophilic (N=1.124), non-biophilic (N=533), and biophobic (N=581). In addition, we acquired a product set consisting of 95 product images that were evaluated as biophilic, non-biophilic, biophobic, or none.

The word pool was examined in comparison with the categorizations of biophilic values, elements, and attributes in the literature on biophilic environmental design which are A Typology of Biophilia Values (Kellert, 1993), General Features of Nature (Heerwagen, 2003), Biophilic Elements and Attributes (Kellert, 2008), Seven Attributes of Nature (Heerwagen & Gregory, 2008), 14 Patterns of Biophilic Design (Browning et al., 2014), Experiences and Attributes of Biophilic Design (Kellert & Calabrese, 2015), and Eight Points of the Biophilic Effect (Salingaros, 2015). Stephen Kellert's two categorizations became prominent by being the most relevant ones to product design principles and values. Biophilic design elements are suggested in a very detailed way in *Elements and Attributes* of Biophilic Design (Kellert, 2008) while the chart A Typology of Biophilia Values (Kellert, 1993) presents more concise and abstract values. All the words in our word pool were distributed into the titles of both charts according to the explanations of each.

The chart (Table 2) "Elements and Attributes of Biophilic Design" (Kellert, 2008) is too broad at some points; yet lacks product-specific design elements and attributes. Since Kellert's (2008) categorization had been proposed for architectural and urban design, no words were listed under the titles exclusive to these realms. For example, the titles about space and light, like 'Geomorphy' and 'Filtered Diffused Light' were not applicable for product design due to the difference of the realm such as scale, design elements, and the environment. Also, the product-specific words in the pool didn't fit under any title of the chart. A bulk of words which needed categories like 'Human Scale', 'Human-Friendly', 'Natural' (as a specific title), 'Aliveness' (as a specific title), and 'Energy' as peculiar to the realm of product design stayed out. Titles like 'Central Focal Point', 'Light as Shape and Form' and 'Complementary Contrasts' remained empty even though they were

Table 3. A typology of biophilia values (Kellert, 1993, p. 59).

	A Typology of Biophilia Values						
	Definition	Function					
Utilitarian	Practical and material exploitation of nature	Physical sustenance/ security					
Naturalistic	Satisfaction from direct experience/ contact with nature	Curiosity, outdoor skills, mental/ physical development					
Ecologistic- ScientificSystematic study of structure, function, and relationship in nature		Knowledge, understanding, observational skills					
Aesthetic	Physical appeal and beauty of nature	Inspiration, harmony, peace, security					
Symbolic	Use of nature for metaphorical expression, language, expressive thought	Communication, mental development					
Humanistic	Strong affection, emotional attachment, "love" for nature	Group bonding, sharing, cooperation, companionship					
Moralistic	Strong affinity, spiritual reverence, ethical concern for nature	Order and meaning in life, kinship and affiliational ties					
Dominionistic	Mastery, physical control, dominance of nature	Mechanical skills, physical prowess, ability to subdue					
Negativistic	Fear, aversion, alienation from nature	Security, protection, safety					



Figure 2. Product set (N=18) obtained at the end of the 1st expert group study which was used throughout the research (see Appendix).

expected to be associated with product design. Kellert's (2008) chart 'Elements and Attributes of Biophilic Design' was a functional starting point to reveal the differences between architectural and product design in respect of the biophilic design approach. However, we decided to continue with A *Typology of Biophilia Values* (Kellert, 1993) due to its more comprehensive and abstract formation (Table 3).

The words that were associated with 'non-biophilic' and 'biophobic' were mostly the same even though there were some exceptions. Most of the participants of the 1st expert group found the concept of non-biophilic 'vague'. It appears to be a consistent result considering the infrequency of the concept of 'non-biophilic' and the lack of a detailed definition of it in literature. Similarly, Salingaros (2015) criticized modern architecture and designated it as biopho-

Table 4. The biophilic and non-biophilic/biophobic words related to the biophilic product dimensions.

	Biophilic	Non-biophilic/Biophobic
Form	aesthetic, asymmetry, natural, comfort, curvilinear, ecological, ergonomic, flowing, harmonious, natural, plant, plain, tree, useful	cornered, disproportional, geometric, homogeneous, sharp, smooth, straight
Functional	comfort, easy to use, ergonomic, fit for purpose, functional, practical, harmonious, useful	mechanical
Material	animal, archaic, durable, ecological, fit for purpose, flexible, fluid, handmade, healthy, innate, matte, natural, plant, sense of belonging, soft, tree, vivid, warm, wish to touch, wooden texture	artificial, fake, fragile, homogeneous, shiny, sterile
Psychological	adorable, calm, contented, comfort, ergonomic, familiarity, hugging, loyalty, peaceful, positive, safe, sense of belonging, sincere, soft, spaciousness, strong, sturdy, useful, warm, wish to touch	attacker, cold, dangerous, disgust, far-fetched, loneliness scary, unlikeable
Sensorial	bright, calm, matte, spaciousness, soft, tree, vigorous, vivid, warm, wish to touch, wooden texture	cold, darkness, loneliness, sharp, shiny
Semantic	archaic, contented, familiarity, holistic, humanist, interesting, loyalty, positive, still, sympathetic	disgust, geometric, loneliness, unnecessary

bic instead of non-biophilic, due to the characteristics of sharp, perpendicular, and geometrical lines, and lack of details, smooth and shiny surfaces. Thus, the number of qualifiers decreased to two as 'biophilic' and 'non-biophilic/ biophobic' since it supports the research question better. At the end of this study, we had a product set consisting of 18 product images (Figure 2) that the 1st expert group mostly agreed on assessing as biophilic or non-biophilic/biophobic; and the word set.

At that point, we did an exploratory study to understand the potential of the word set and the product images. A user survey was designed with the 30 most frequent words in the set and the 18 products to be associated by the participants. The words are in alphabetical order: *aesthetic*, *alive*, *aversive*, balanced, cold, comfortable, complicated, dangerous, dirty, disproportionate, fear, forced, functional, harmful, harmonious, healthy, hygienic, interesting, natural, plastic, primitive, random, regular, safe, shiny, simple, strong, sympathetic, unknown, warm. Each word corresponds to three types of identifiers: the first is being biophilic or not, which is defined by the 1st expert group; the second is biophilic values that are stated by Kellert (1993); and the third is the hypothetical biophilic product dimensions, proposed by the researchers as 7 dimensions (see Table 1). This exploratory study was expected to provide insight into the participants' experience of taking the survey. A group of 29 participants (2nd user group), took part in this study. 20 of the participants were female and 9 were male, the average age (M=33), and the professions included academics, engineer, attorney, designer, finance expert, news speaker, physician, teacher, and student. 18 of the participants responded to the survey online while 11 of them were observed by the researcher in person during the survey. The participants were given a form consisting of 18 pages with one product image on each and the random-ordered 30 words under the product images. The participants were asked to choose 10 words out of 30 that they associated with the products and evaluate those 10 words on 5 points Likert scale. The participants were also asked if they would prefer to use that product or not. In addition, the participants evaluated their survey experience about clarity, difficulty, and completion period.

The study revealed that the survey took 30 minutes on average to be completed and it was quite a cognitive load for the participants to relate 10 out of 30 words to 18 different products each. On the other hand, 30 words did not constitute that large a set to be distributed into Kellert's (1993) 9 titles and 7 biophilic dimensions of biophilic product definition.

Separating the work of the word-products association and the user preference survey would provide more effective results by allowing us to design a briefer survey enabling a larger reach of participants. Also, assigning experienced designers to associate the words and products would provide more reliable results due to their experience and knowledge of the semantics of products. Since the association work would be done by an expert group, an opportunity to expand the word set had emerged increasing the reliability of the study.

Form	Function	Material	Psychological	Sensory	Semantic
Asymmetry	Consistency	Color	Comfort	Color	Connotation
Amorphous	Ergonomics	Indigenious	Emotions	Feeling	Emotions
Balance	Expediency	Natural	Familiarity	Odor	Historical
Ergonomics	Productivity	Texture	Feelings	Rhythm	Identifiability
Geometry			Loyalty	Sound	Story
Identifiability			Safety	Taste	Symbolic Value
Integrity				Texture	
Organic				Vibration	

Table 5. Revised biophilic product definition with its dimensions and qualities.

The word pool was revisited and the repeated words were picked. The near-synonymous words were grouped and eliminated to be represented by the most frequent ones. Thus, the number of words was downsized to 112. The larger the word set, the more detailed and objective work is necessary to distribute the words into Kellert's (1993) biophilic values and the hypothetical biophilic dimensions. And so, another expert group (2nd expert group) comprising 15 academics from the fields of Industrial Design, Interior Design, and Psychology was consulted to match the words to the values and the dimensions. The 2nd expert group was given a form which includes Kellert's (1993) 9 values (Utilitarian, Naturalistic, Ecologistic-Scientific, Aesthetic, Symbolic, Humanistic, Moralistic, Dominionistic, Negativistic) and 7 biophilic product dimensions (Attitude, Form, Functional, Material, Sensorial, Semantic, Psychological) as 'titles' and the 112 words to be matched.

All the titles and matched words were put into a table. The words that 7 members of the 2nd expert group agreed to relate to a title were selected to be used in the rest of the research. Even though 8 to 15 provides the majority rule, acquired words would be significantly lower in the case of selecting 8 agreements. To keep the richness of the data, 7 was preferred to be the threshold. This study showed that the words of biophilic product dimensions cover the ones under Kellert's values. And also, functional dimension words cover the words of attitude dimension. Consequently, the biophilic product came to be defined by 6 dimensions: form, functional, material, semantic, sensorial, and psychological. Kellert's (1993)

Negativistic value which indicates biophobia wasn't included as a separate dimension but embedded into each dimension through the non-biophilic/ biophobic words. The last version of the word set with the negativistic values can be seen in Table 4.

At the end of this stage, the total number of words was 78; some associated with more than one dimension. Accordingly, the biophilic product definition and its dimensions were revisited based on the second expert group review of Table 1. Table 5 shows the revised version of the dimensions and their qualities which are achieved at the end of the 2nd expert group study.

2.2. Stage II: The effects of biophilic dimensions of products on the user preferences

This stage consists of another expert group study (3rd expert group) and a new user group study (3rd user group), and quantitative analysis methods such as reliability tests and linear multiple regression analysis. The 3rd expert group was composed of 6 groups with 20 participants in each. The participants were chosen according to their academic and/or professional design expertise on the specific dimension of the biophilic product as form, functional, material, semantic, sensorial, and psychological. All participants major in Product Design except the psychological dimension group. That group has participants who are academicians in the field of Psychology besides the designers.

The 3rd expert group was asked to evaluate the 18 products (see Figure 2) regarding the relationship with the words that were assigned to each dimension. The study was held via an online survey that had 18 pages attended

Table 6. Model summary of Linear Multiple Regression Analysis of biophilic dimensions.

Dimension	В	SE	β	95%	% CI	р
				LL	UL	-
Constant	.172	.504		897	1.241	.737
Biophilic Functional	.966	.158	.837	.631	1.300	.000
R ²	.701					

Table 7. Model summary of Linear Multiple Regression Analysisof non-biophilic/biophobic dimensions.

Dimension	В	SE	ß	95%	CI	р
				LL	UL	
Model 1						
Constant	.682	.436		242	1.606	.137
Non-biophilic / Biophobic Functional	.854	.144	.830	.549	1.158	.000
R ²	.688					
Model 2						
Constant	2.500	.886		.611	4.389	.013
Non-biophilic / Biophobic Functional	.571	.178	.555	.192	.951	.006
Non-biophilic / Biophobic Psychological	528	.232	394	-1.022	035	.038
R ²	.769					

to each product image. The words that belong to each dimension were placed below the image with a 5 point Likert scale. 1 indicated "Not relevant at all", and 5 indicated "Certainly relevant".

The evaluation scores of each dimension were tested for reliability in two sections as biophilic and non-biophilic/ biophobic. The reliability tests were run by the software of SPSS 27 and the reliability threshold was set as Cronbach Alpha α >.7) and the Item-Total Correlation coefficient as .25. The words that have negative item-total correlation coefficient values were re-coded by using the complementary value to 5. The words under the reliable threshold were removed from the word set and the average scores of the remainings revealed the scores of the products for every 6 dimensions as both biophilic and non-biophilic/biophobic cases. These scores were used as the predictors, the independent variables of the regression analysis which has been done to analyze how the biophilic dimensions affect the user preferences.

The same 18 product images were used in the user survey which was held online and by snowball sampling without any limitation of age, gender, education level, etc. The participants (N=1.206) were asked to evaluate the products how they preferred to use them via a 5 points Likert scale. 1 indicated "I would certainly not prefer to use it", and 5 indicated "I would certainly prefer to use it".

Therefore, the qualitative data were transferred into the quantitative data as both biophilic product dimensions and the user preferences for a product set (N=18). To understand the effect of the biophilic product dimensions on the user preferences, the data was run on Multiple Linear Regression Analysis by the software of SPSS 27. The analysis was run separately for biophilic and non-biophilic/biophobic dimensions. The biophilic product dimensions were independent variables while the user preferences were dependent variables for both analyses.

3. Results

The results of the multiple linear regression analysis indicate the multicollinearity between the psychological dimension and the semantic dimension in both biophilic and non-biophilic/biophobic cases. The correlation coefficient between the biophilic psychological and the biophilic semantic dimension is .885 (>.8) (p=.000<.05); while in non-biophilic/biophobic case the correlation coefficient is .804 (>.8) (p=.000<.05). Similarly, there is multicollinearity between the biophilic material dimension and the sensorial dimension as the correlation coefficient is .902 (>.8)(p=.000<.05).

The only dimension that has a significant result is the functional dimension ($p_{functional}$ = .000<.05) in the biophilic case (Table 6). The biophilic functional dimension explains 70.1% of the variance predicting the user preferences R2= .701, F(1, 16)=37.502, p<.001, 95% CI [.601, 1.300]. Five dimensions other than the functional dimensions has not significant results ($p_{semantic}$ = .224 >.05, p_{form} = .768 >.05, $p_{sensorial}$ = .722 >.05, $p_{material}$ = .525 >.05, $p_{psychological}$ = .109 >.05).

Besides, the biophilic psychological dimension has the highest partial correlation value (.402) over the other four ($p_{psychological}$ = .109 >.05). The multiple regression analysis was run again with the removal of semantic dimension to resolve the multicollinearity between the semantic and psychological dimensions and catch the significance value; however, the significance value couldn't catch the threshold (p=.05).

In the non-biophilic/biophobic case, the functional $(p_{functional} = .000 < .05)$ and psychological (p_{functionalpsychological}= .038<.05) dimensions have significant results (Table 7). The non-biophilic/ biophobic functional dimension explains 68.8% of the variance predicting the user preferences R^2 = .688, F(1, 16)= 35.313, p<.001, 95% CI [.549, 1.158]; while non-biophilic/biophobic functional and psychological dimensions explain 76.9% of the variance R^2 = .769, F(1, 15)= 5.205, p<.05, 95% CI [.192, .951] and [-1.022, -.035]. The partial correlation coefficient of the non-biophilic/biophobic psychological dimension has a negative value -.508 $(p_{psychological_non} = .038 {<} .05)$ which means that non-biophilic/biophobic psychological dimension is inversely related to the user preferences.

4. Discussion

The detachment of humans from nature has been getting more compelling with the developments in technology and urbanization, which in turn is associated with many psychosocial problems affecting general physical and psychological well-being (Dean et al., 2018). Given that many of the resulting technological and human-made environments are structurally and functionally irreversible, arguably the best approach to restore human well-being may be the nature-centered approaches such as biophilic design (Kellert, 2005). However, to the best of our knowledge, there is no empirical effort in product design literature testing the effects of biophilia on the user preferences of products. In addition, while the biophilic approach has been widely accepted and integrated in Architecture and Urban Design, traces of the same interest cannot be found in the field of Product Design. This shortcoming may be partly due to the lack of a basic study in the field of product design to identify the qualities that make a product biophilic.

In this regard, the primary aim of the present study was to investigate the defining characteristics of the concept of biophilia in product design. After all, as the important parts of the built environment, products are worth investigating in terms of the biophilic approach. The second aim of this study was to evaluate the effects of biophilic design features on user preferences. Thus, determining biophilic product dimensions and characteristics along with investigating their effects on the user preferences would be an important contribution to the product design literature for its future development and integration.

The study consisted of two stages. The first stage focused on identifying the product-specific biophilic dimensions and determining the defining characteristics of a biophilic product, the second stage focused on investigating the user's preferences of biophilic dimensions of a product. Here, several significant aspects of the present study will be highlighted.

First of all, a series of empirical studies providing us with both qualitative and quantitative analysis which aimed at the literature gap in biophilic product design was held. A whopping total of 1.414 participants served as users (N = 1.239) and experts (N = 175) in the study, one of its kind for its sample size.

As the closest fields to industrial design, architecture and urban design had already provided biophilia literature with a body of categorizations on biophilic elements, attributes, and values. Taking advantage of this, we included those categorizations in our framework for further inspection within the context of biophilic product qualities. Our first findings revealed that they were too comprehensive for products at some points while lacking some of the product-specific elements. Therefore, at the end of the first stage of this research, we obtained a set of biophilic dimensions of products on the grounds of, but not limited to, biophilic architectural and urban design principles. "A Typology of Biophilic Values" (Kellert, 1993) as the most relevant categorization to products by being more conceptual and inclusive was chosen as an initial point and his set of values were employed throughout the empirical studies carried out to identify the biophilic product dimensions.

Another significant contribution of this study is the higher resolution it provides to the definition of a biophilic product. We hypothesized at the outset that qualifying a product as biophilic should be based on a multidimensional evaluation rather than a binary one such as biophilic or not. Consistent with our prediction, our results indicated that the definition of biophilia in products accommodated multidimensionality. Thus, a product might be defined through 6 biophilic dimensions as form, function, material, semantic, sensory, and psychological dimensions.

The results of the second-stage works investigating the role of the biophilic dimensions in the end-user preferences revealed that the functional dimension was significantly effective on the preferences in both biophilic and non-biophilic cases. On the other hand, the psychological dimension was effective on 'not to prefer' in the non-biophilic cases. Moreover, the significant multicollinear relationships between the psychological and semantic dimensions and between the material and sensorial dimensions could be associated with a need for a reduction in the number of dimensions which conveniently simplifies the definition of biophilic product.

Another interesting finding of this study was that although we have evidenced at the first stage of the study that form, material, semantic and sensory dimensions were cognitive criteria available in the evaluation of products regarding biophilia, none did reach the level of statistical significance in predicting the preferences of end-users. This finding may point to several important aspects of user preferences. First, end-users typically prefer using simpler mechanisms, as opposed to more complex ones in their decision-making. This is particularly true when the task involves evaluating through 2-dimensional (2D) images since some of the cues signaling all the qualities of the product have become rather vague in a 2D version. The cognitive complexity of the assessment of a product presented in a 2D plane may

be too high for a layperson to process, even though it is quite low for an expert. Hence, the end-users would be expected to employ a cognitively more parsimonious strategy of preference which is presumably based on criteria that are more critical to them. In line with this expectation, the user participants in our study used only the functional and the psychological criteria in their evaluations. Thus, we hypothesize for future inquiries that these two criteria may be the most applicable of all others to real-life situations, especially, when there is only a limited amount of information available about the product of interest.

Second, the task required for the user participants to perform was assessing the products which had neither personal or sentimental nor possessional relations with themselves. Since the products present experiences to users mostly in emotional, social, and cultural contexts (Heskett, 2002; Margolin, 1997) the end-users would be likely to make evaluations based on a wider range of criteria for the products with which they are in emotional/possessional relationships. But as Boztepe (2007) indicated products create value in the eye of the user as they interact with their user and fit their daily lives. Since the products evaluated were not in the reach of users, those four dimensions might have not manifested themselves due to the 2D exposure procedure we followed in this study. Apparently, future studies are needed to test the effects of emotional, possessional, and functional variables of user-product relations.

The initial structure of this research was constructed on biophilic design aspects in Architecture and Urban Design. Together with empirical data collected specific to the research design and experience gained along the way, led to determining product-specific biophilic dimensions attributed to the realm of Industrial Design. Architecture and products differ explicitly from each other regarding scale, lifecycles, materials, spatiality, mobility and locality, uniqueness, and more can be listed. The reflections of these differences in terms of biophilic aspects and dimensions in our study would be more informative when the end-products are examined with users' relations to them. For instance, a building is often less individual and personal compared to an industrial product which even may include intimacy.

This intimate relationship is often described as an emotional attachment (Desmet & Hekkert, 2007; Norman, 2004) of the user to the product. Norman (2004) also draws attention to product customization as it reinforces the bond between the user and the product. Products offer different values. Owning a product signifies something beyond its utilitarian value; for example, symbolic values imply social status and prestige (Baudrillard, 1981). Although in architecture and urban design this personal attachment has a weaker character, adoption of habitat aspects such as light, water, color, and vegetation are theorized as being inherent in everyone. These characteristics have been suggested as evolved psychological mechanisms by several theories such as Prospect & Refuge Theory by Appleton (1975), Savannah Hypothesis by Orians (1980), Habitat Selection Theory by Orians and Heerwagen (1992), Attention Restoration Theory by (Kaplan & Kaplan, 1989). However, the ways we interact with spaces and tools are different in evolutionary terms, even though they are both human-made structures (Boyer & Barrett, 2016). Thus, these theories do not shed light on the adaptive roles of design products.

A product is, in a sense, an extension of the user. After all, the desire for possessing a tool to "get the job done" has been one of the most significant cognitive adaptations humans acquired through their long evolutionary history (Petroski, 1992). Each tool is a design product, and we have been using them for getting and preparing food, carrying and storing, making clothing, recording information, art and music, and for many other things since the stone age. Making tools advanced humans to overcome survival needs like hunting, and foraging (Barrett, 2016), also making other tools (Petroski, 1992), and became one of the most significant indicators of cultural evolution (Whiten et al., 2011).

Given its universal role in survival and reproduction, this powerful urge to make, own, and use tools still heavily influences our product preferences in our minds today. As Boradkar (2010) indicated these things serve to enhance, not only the physical and mental competencies but the personal and communal sense of identity of people. Our end-user data clearly support this compelling presumption. Evidently, our user participants distinctively relied on psychological and functional aspects of the products in their decision of preference, which presumably reflected the long-lived desire of being in the personal distance with the product, and using it to achieve goals.

The question of why user-participants made their evaluations based on the function begs further elaboration, probably by referring to the cognitive mechanism of product evaluation. Biophilic preferences of products of the user participants were dominated by the product functionality. This observation calls forth an interesting aspect of biophilia as a cognitive capacity. Our preferences of products are determined both by the information provided by a product and the associated information available in our long-term representations. Accordingly, the congruency between a product and the best-fitting mental representation of the product creates a sense of familiarity in the user's mind. When there is a lack of familiarity, the product initially tends to elicit aversive reactions from the user. This is produced by a fast and dirty emotional system. As the familiarity increases, a slow but clean system of evaluation kicks in. Finally, whether appetitive (positive) or aversive (negative), our impressions of the product are stored in the long-term representational system (namely the long-term memory).

This representation system of biophilia (including both biophilic and biophobic representations) plays a role in our product preferences because the neurobiological markers which guide the emotional process in choice behavior have been fashioned by evolutionary mechanisms (Bechara & Damasio, 2005). For the same reason, natural environments are consistently preferred to human-made environments (Kaplan, 1992), viewing pictures of nature scenes decreases physiological distress (Ulrich, 1983, 1986), and the presence of flowers in a hospital room increases the recovery rate of patients (Ulrich, 1986).

Toolmaking for protection from predators, hunting, gathering, and making other tools has been essential for human survival not only during the Pleistocene era but also now in the modern era (Bailey & Geary, 2009). This study reveals that user preferences of products are significantly under the effect of functional dimension. We may say that there is a strong similarity between the toolmaking for survival in savanna and the architectural needs of sheltering, hiding from predators, watching the prey, finding food, etc. regarding their importance being still valid today (Biro et al., 2013). Also, attraction to artifacts and object-guided learning have an adaptive role in human evolution (Fragazsy et al., 2013). Then, the user makes their preference regarding the potential fitness contribution of the product. This stage calls forth the functionality of the product.

The aversive attitudes of the users towards the non-biophilic/biophobic psychological dimension, which we observed in the present study, are compatible with the biophobic responses of organisms to biophobic objects in their natural environment. Biophobia is an inherent mechanism that helps the living being to survive with the help of fear, revulsion, and avoidance (Bracha, 2004). Consistently, non-biophilic/ biophobic functional and psychological dimensions of products are significantly effective on the user preferences. We may conclude that biophobia still has a strong effect on modern human preferences. In every stage of the study, the strength of biophobia made itself evident. The interviews with the 1st expert group concluded with more consistent words of biophobia than the words of biophilia. Also, the analysis of the effects of biophilic dimensions on the user preferences showed that the non-biophilic/biophobic psychological dimension had significant results while the biophilic psychological dimension couldn't reach the significance threshold.

The number of the product images did not exceed 18 not to pose cognitive load for the participants in the empirical studies. Since the common ground of all studies is the set of the product images, the sample of the regression analysis needed to be N=18. This small sample has occurred as the limitation of the study which can be overcome by increasing the number of the products to achieve more efficient and comprehensive results in further studies. Thus, the significance value of the form, material, semantic, and sensorial dimensions may increase. For instance, the biophilic psychological dimension couldn't reach the significance threshold, however, it has the second-highest partial correlation coefficient after the biophilic functional dimension. Higher significance values would be expected in a larger sample. Besides, a physical evaluation, interacting with the products in person, rather than over a digital representation would enhance the quality of the users' evaluation as a further study suggestion.

Alternatively, a further study could be formed through the products which the users have already possessed. The researchers would be sure that those products have been preferred and possessed, thus having a connection with their users. In addition to enlarging the product sample size, the user participants would be diversified to get an insight into how the cultural and geographical differences manifest into biophilic dimensions.

Relating the concept of possession -an issue in material culture studies- with biophilia in users' tendency can be a promising frame for further study. In understanding the subjective nature of possession apart from objective limitations such as purchasing power, level of education, aesthetic literacy, biophilic properties may be an operational tool in revealing the dimensions behind ownership of objects, their meanings, and evocation embedded in materiality. The functions of products surpass utility functions and they respond to human's search for meaning, constitute one's and society's material memories, provide communication and interaction

(Boradkar, 2010; Kwint, 1999; Norman, 2004). All these issues beyond utility are anywise related to culture. Biophilic approaches, in general, adopt the idea of interaction between nature and nurture; accepting natural and cultural approaches as complementary rather than conceptualizing them as dichotomous since they are the products of the evolution of the human mind and they are in a sustained biotic relationship (Chudek et al., 2016; Kellert, 2005; Wilson, 1998, 2008). Hence, the dichotomy between nature and culture has been effectively criticized by theoreticians such as Harraway (1991) and Latour (1999/2004). Extending material culture studies through the lens of biophilia within the dissolution of such dichotomy would be a significant contribution to the field.

Within the introduction of new modes of products such as services, intangible goods, and digital possessions in virtual environments, experiences, and interaction where design plays a crucial role, biophilic dimensions are worth searching especially in terms of psychological, functional, and symbolic means. The expansion of the boundaries of product and production realms might be a significant actor within the current research environment based on the co-evolution of technology and nature. The studies on employing technology to enforce biophilia and nature-relatedness (Buettel & Brook, 2016; Kahn, Jr., 2011) seem to be a promising field for design to be involved. Uncovering the potentials of biophilic design and introducing metrics related to biophilic dimensions of design to reach higher human centeredness leading to business success can be promising in calming down tensions between different actors in the design and production realms.

To conclude, this study doesn't claim to produce absolute judgment on the biophilic product qualities. Instead, it is one of the steps paving the way to "biophilic product design principles". Both the biophilic product definition and the word set may be improved by considering the multi-faceted structure of the products and may enrich the literature related to biophilic product qualities.

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Appendix

[Cradle]. (n.d.). Pinterest, shorturl. at/krtA1

[Cube-formed salt and pepper container]. (n.d.). Pinterest, shorturl.at/ irxJN

[Cutipol Cutlery]. (n.d.). Pinterest, shorturl.at/jEW15

[Farmhouse kitchen faucet]. (n.d.). Pinterest, shorturl.at/cnyX2

[Finn Juhl Lobby Chair]. (n.d.). Pinterest, shorturl.at/iqHLU

[Geometric salt and pepper container]. (n.d.). Pinterest, shorturl.at/horzA

[JOSEPH JOSEPH Catcher Citrus Reamer]. (n.d.). Pinterest, shorturl.at/ ilosE

[Juice Bruce Lemon Squeezer]. (n.d.). Pinterest, shorturl.at/bAFKS

[Leafy Faucet]. (n.d.). Pinterest, shorturl.at/vDTV1

[One Piece Knife]. (n.d.). Pinterest, shorturl.at/rCHT1

[Quetzal Chair]. (n.d.). Pinterest, shorturl.at/wHM23

[Rose gold faucet]. (n.d.). Pinterest, shorturl.at/fgpAJ

[Salt and pepper pinch bowls]. (n.d.). Pinterest, shorturl.at/tGXY1

[Sieve]. (n.d.). Pinterest, shorturl.at/ jrJMY

[Silver cutlery set]. (n.d.). Pinterest, shorturl.at/bjBT0

[Terri Kern Salt and Pepper Shak-

ers]. (n.d.). Pinterest, shorturl.at/oqFJ2 [The Diatom Chair]. (n.d.). Pinterest, shorturl.at/gDZ04

[Wooden chair]. (n.d.). Pinterest, shorturl.at/muLP6

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The changing customs of architectural design: The effects of building information modeling in a local context

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Abstract

The tools used in architectural design processes have always been effective in design activities. BIM methods, which are used as new technological tools and design modes by an increasing number of architectural firms today, have the potential to make a similar impact because they introduce a new logic Therefore, it is a critical issue to examine the change created by BIM in the design processes. In this context, this study examines the potential transformations that BIM can create in architectural design processes with a theoretical approach; It also explores the practical validity of theoretical assumptions. In line with these objectives, a three-pronged methodology was adopted in the study. First, the transformation created by BIM was conceptualized as a holistic digitalization in the field of architecture. Secondly, previous studies on BIM were examined, according to this, the possible effects of BIM on architectural design processes were gathered under three headings and the possible direction of the effects in these three areas was explained theoretically. Finally, the theoretical assumptions were reassessed through interviews with people actively working in the practical field. The inferences obtained at the end of these three stages are evaluated in the discussion section. In consequence, the paper attempts to reveal the transforming mechanism of architectural design practice under the influence of BIM as a new form of knowledge that enables the storage and management of design data. In this context, it aims to be a source for future studies on the orientations of architectural design practice and education.

Keywords

Building Information Modeling, Design knowledge, Design simulation, Collaboration in design, Performance in design.

1. Introduction

Architecture is undergoing a profound change due to the advent of information technologies and the demands of the building industry. Building Information Modeling (BIM), which is a digital design approach that enables a design to be embodied in a digital, associative, parametric, three-dimensional (3D) environment, is one of the most influential factors of this change. In BIM applications, design information is stored on a digital model that can be shared among designers, consultants, contractors and asset owners. Any two-dimensional (2D) projection of a design can be created from this model, and so, the need to produce 2D drawings by hand or by digital applications that allow 2D drafting gradually disappears (Atkins & Mendelson, 2016; Eastman et al., 2011; Tan & Paker-Kahvecioğlu, 2019). In this way, 3D information models replace conventional orthogonal drawings and become one of the central themes in the computerization of architectural practice (Andia, 2012).

This substantial change in architecture is an important topic to study because the profession is mainly built upon the process of producing 2D design documentation. Drawing sets such as plan-section-elevation triplets and the labor to prepare these representational documents have been a determinant of the design process, design approaches, and the priorities of architects (Carpo, 2014, 2011, 2001; Evans, 2000; Pelletier & Pérez-Gómez, 2000). The structure of design offices and workflows, social image, and the professional relationships of architects and their clients and employers have been based on the labor of creating 2D projections. Therefore, the replacement of drawings with digital 3D information models changes many conventions in the profession (Kalay, 2006; Oxman, 2006).

Different stages of the design and construction of a building strongly interrelate with each other; and BIM has minor or major impacts on all these phases, as well as design processes. However, this study only focuses on the changes that BIM has made in architectural design processes in practice, associated with the end of the effort to produce 2D technical documentation.

There is plenty of research that addresses BIM from a technical point of view, however, studies on how BIM can alter the architectural design practice are still rare. There is almost no study that sees BIM as a method that ends the production of manual two-dimensional technical drawings and examines its effect in this sense. Architectural theorists have comments on the subject (Cardoso Llach, 2012; Carpo, 2014; Scheer, 2014), but there is no study examining these theoretical approaches in the practical field. In the literature, studies related to BIM in architecture have either focused novelties brought by BIM in various topics such as collaboration in design processes, object-oriented design, optimization of design and construction processes, etc.; or research has been conducted on the integration of BIM into design and engineering education curricula. However, before considering the integration of BIM into design processes and design education curriculum, it is critical to question how BIM methods and processes differ from traditional design methods and processes.

In accordance with this purpose, this study both presents a theoretical approach to possible transformation that BIM, as a set of tools and methods that eliminates the labor for the production of 2D technical drawings, creates; and investigates whether theoretical assumptions have practical counterparts.

In this context, the paper is structured in five chapters including the introduction. In the second part following the introduction, the research approach and methods are explained. In the third section, the background of the theory revealed by the study is explained, and in the fourth section, the inferences obtained from the field research carried out to reveal the counterparts of the theoretical approach in architectural practice are given. Finally, the fifth section is the conclusion section.

2. Research approach and methods

In regard to construct a theory about the transformation created by BIM and to find the practical reflections of these theoretical assumptions, a three-stage methodology was adopted in this study.

First of all, BIM was considered as the key to the transition from modern

Pre-modern Narrative Knowledge	Modern Scientific Knowledge	Postmodern Information
Holistic	Fragmented / Hierarchic	Fragmented / Reticulated
Multicentered distribution	Single centered distribution	Centerless distribution
Culturally legitimate	Scientifically (based on proof) / Legitimate	Legitimization is inessential
Determines proficiency measures	Proves proficiency	Testable
Shows application	Determines application standards	Applied, tested and reapplied

period techniques and approaches to digital age techniques and methods in design processes; and this transition was conceptualized on the basis of ideas by Jean-François Lyotard in his book Postmodern Condition: A Report on knowledge (1984). In this study, Lyotard unveils the relationship between the common form of knowledge and the legitimization mechanisms in the organization of society. If Lyotard's discourse is applied to architecture, it can be seen that the transformation of the way design information is stored and transmitted has effects on architecture, similar to the changes experienced in other sub-structures of a society.

In this regard, three main forms of knowledge were taken from Lyotard. These are summarized as narrative, scientific, and informative knowledge. The main features of each form are briefly given in Table 1.

Second of all, BIM is investigated as an informational form of knowledge in architecture, in accordance with Lyotard's views and the transition from the scientific form of knowledge to the informational form of knowledge in architecture is inquired based on discourse analysis; and a theory is constructed accordingly.

Finally, semi-structured interviews with people from four different local design offices were used as a field research method and the inferences obtained from these interviews were evaluated in comparison with the constructed theoretical approach.

The offices were chosen from among a selection of architecture firms in which BIM tools are employed at different stages. Two of these offices are medium-sized (with 5 to 15 employees) offices (Office1 and Office 2). Although BIM tools have been used in these offices for more than 10 years, they are not used as an integrated design method, but rather as a set of tools that accelerate in-office production. The other two are medium-large-sized companies (with more than 15 employees) and they have used BIM tools in large-scale projects as a means of collaborating with other stakeholders of the projects (Office 3 and Office 4) (Table 4).

In the next section, the theory based on Lyotard's philosophy and developed with inferences from discourse analysis will be explained; in the following section, the answers obtained from the interviews will be addressed.

3. Background and theory

According to Lyotard (1984), the proliferation of information-processing machines would have a huge effect on the decision mechanisms of a system. Lyotard (1984, p.14) stated that: "Increasingly, the central question is becoming who will have access to the information these machines must have in storage to guarantee that the right decisions are made?" These circumstances are also valid for architecture as an organization. The person with the information, who can manage that information, will have control of the design and the realization processes. Since BIM requires as much information as possible to design the buildings' well-defined digital equivalents, it emerges as the dominant form in terms of informational knowledge in the architectural field, and hence, its use causes a paradigm shift.

There are various views in the studies on the possible effects of BIM in different areas of the architecture and construction industry. David Ross Scheer (2014) argues that among the differing and plenty of digital tools, especially BIM methods and tools have the power to radically transform professional practice, as they offer a new simulative medium. Scheer especially drew attention to the visualization capacity of BIM tools in detail and in different projection planes. Mario Carpo (2014) have described BIM as a digital transformation with the potential to realize the utopia of collaboration in design. In addition, there are

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plenty of various studies on the use of BIM systems for collaboration (Andia, 2012; Azhar et al., 2012; Briscoe, 2015; Idi and Khaidzir, 2018; Ma and Sacks, 2016) or buildings' performance evaluation (Kang, 2020; Na et al., 2020). As a result, the effects and potentials of BIM in the AEC industry have been examined and discussed excessively in speculative or research-based studies.

This study is aimed differently to deal with all aspects of the effects that BIM tools can create especially on the design processes. For this reason, all possible modes of affection discovered in literature review are grouped under three main headings. One of these is the "notation", the other is "the social role of the architect", and the last one is "the tendencies of architectural design" (Table 2).

These three areas of transition are explained below, and the possible direction of the shift in each area with the effect of information modeling is demonstrated. While theorizing the transformation in architectural design practice in the transition from a scientific knowledge form to an informative knowledge form, previous architectural design mediums are discussed to present a comparison.

3.1. Notation: From representation to simulation?

The change in notation can be conceptualized as a shift in modes of expressing design, from representational indication to simulative substitution. This replacement changes the way of creating an architectural form and causes skepticism about the emergence of meaning in this creation.

Representation and simulation can be conceived as forms of notation that are variations of each other. Although, in broad terms, they can be considered as a way of perceiving the world, in a narrow sense, they are modes of expression (Scheer, 2014). For instance, since the Renaissance, the mode of notation in architectural design has been representational and the dominant form of representation has been drawing (Tschumi, 1994). Before the Renaissance, architectural information did not have a projected form that could enable the exchange of information between practitioners prior to construction (Carpo, 2001).

Table 2. Main areas of BIM affection in architecture.

Change of Notation	Change of the Architect's Social Role	Change of the Design Tendencies	
From Representation to Simulation	From Author to Leader / Team Partner	From Function to Performance	

Table 3. The effects of different forms of knowledge on architecture.

	Pre-Modern	Modern	Post Modern (Digital)
Dominant Form of Knowledge in Society	Narrative	Scientific	Informational
Architectural Notation	Verbal	Drawing	Digital Information Modeling
Characteristic of the Notation	Descriptive	Representational	Simulational

Italian humanist architect Leon Battista Alberti first put forward the idea that a physical object could be drawn and depicted before it was built (Carpo, 2013). As buildings in the modern era have become more complex, drawing methods have grown to be sophisticated, drawing catalogs have become more comprehensive, and the separation between design and construction have expanded gradually (Luce, 2009). Architecture has therefore undergone transformations in the historical process in relation to its media. The main shifts and effects taken from the literature review are given briefly in Table 3.

When these transformations are examined, although certain breaking points are revealed, it cannot be claimed that any form of knowledge that is periodically dominant for the transmission of design information later disappears completely. However, there are periodically dominant forms of information transfer. For example, the birth of modern architectural design is highly correlated with drawing, which is the dominant knowledge transmission tool of modern architectural design.

Alberto Pérez-Gómez (2005) states that architecture has been divided into a fragmented representational environment since the Renaissance to the present, with the aim of standardization. To delineate buildings so they may be realized more precisely, new ways of producing more defined expressions had been sought and drawing systems developed in parallel with the growing complexity of construction. CAD applications have been basically based on imitating paper-based design (Oxman, 2008). However, in 1975, Chuck (Charles) Eastman, who is considered one of the founding fathers of BIM, stated that drawing was no longer able to provide the necessary information for construction (Eastman et al., 1975). The search for an alternative tool to replace drawing for architectural notation, started in the 1970s, gave birth to the BIM methods (Eastman, 1999, 1976; Eastman et al., 2011; Eastman and Henrion, 1977). Even though this quest has its origins within the architectural profession, the main demand comes from the desire of the construction industry to ensure the production and transfer of more precise, testable design information. This transition parallels the change experienced by other industries in the information age (Castells, 1998; Crotty, 2013). In the information age, where the form of knowledge is informative, not narrative or scientific as Lyotard claims, architectural information is also expected to be stored and transferable in data form by information models. Unlike drawing, which is a representational notation mode of architecture, information models are simulative.

According to Baudrilliard (1994), to simulate means being able to imitate a reality in a way that is indifferent to its origin, and to replace reality-and beyond that-to create a field of truth that is more perfect than the reality itself. Independent of the processes that lead to a situation, a simulation creates a realm of truth by providing merely the symptoms of same situations. This area of truth is what Baudrillard (1994) calls hyperreal. This applies to building information models that aim to be a digital-artificial twin of a building, with the accumulation of a large amount of information on a digital model (Tan & Paker-Kahvecioğlu, 2019). These simulative models equate with reality to the extent that they have a certain consistency. Therefore, there is a perceptional shift in the production and transmission of design information from representation to simulation. The representation is a notation that emphasizes certain features of the object or situation. It is open to questioning and therefore has a productive effect for the design. In simulation, the experienced object is copied. Imitation presents itself as reality, and no information is given about the origin or the development processes of the object. Therefore, the simulative experience is superficial and has no causality (it only refers to itself). It does not encourage any questioning which may create a meaning (Scheer, 2014).

However, this does not mean that there will not be any creativity in a simulation environment. Architectural production in a simulation environment does not have to depend on the dynamics of modern architectural design such as conceptuality and theoreticality. The validity of the design depends on its own digital tectonic presence in a simulation environment that is the new repository of architectural knowledge composed with algorithms and data structures (Clayton, 2015). Therefore, from a Lyotardian point of view, it is inappropriate to worry that the dominant knowledge in architecture is no longer narrative or scientific. Rather, one should understand this new form of knowledge and discover the possibilities of meaning created within it.

3.2. The social role of the architect: From author to leader?

Due to the free dissemination of information, the possibility of cooperation and the simultaneous content production of different groups on a project undermine the social role of the architect as an author, and a new role called team leader/partner emerges. After the Renaissance, the use of abstract representation, drawing in particular, to make decisions about buildings caused architects to gain autonomy. With control over buildings granted by drawing, tool architects have become the authors, as they decide why and how buildings should be built in a certain way. Especially in the first half of the twentieth century, mass production and the use of standardized materials such as steel and glass required more precise documentation for the construction of new buildings. Thus, drawing skills became essential in the profession (Johnston, 2008; Woods, 1999). Later, a new generation of architects, who received an elite education in architecture schools and were equipped with a knowledge of history, theory, and technical drawings, demanded to be accepted as architects in society as soon as they graduated (Cardoso Llach, 2012). These are architects in

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the modern sense of building authors, and their productions form and define professional modern architecture.

In Turkey throughout the twentieth century, architectural education evolved under the influence of foreign architects who trained in Europe and the U.S. The characteristics of the profession are no different from its western counterparts (Bozdoğan and Nalbantoğlu, 2002). The western architectural tradition was transferred to Turkey by some pioneers who trained young architects at the prominent architectural schools of the time. Architectural offices were established in parallel with Europe and the U.S., and architectural practices based on drawing also prevailed (Kafescioğlu, 2019).

Consequently, architects have been recognized as a professional group and as a building's author; who can master modern architectural knowledge-legitimate because it is tried and proven—and by using this knowledge, they can transfer the information through technical drawings. However, in a society where many systems have been automated via digital data accumulation, the relationship between design drawing and authorship also undergoes a dissolution with BIM. The fact that technical drawings are produced not by individuals but automatically by programs affects the modern architect. BIM recombines the architect and the construction of the building not physically but in a digital environment, causing the architects to exchange the role of the author with a new architect figure with abilities other than drawing (Carpo, 2014). With the use of BIM tools in architecture, design and construction are no longer linear processes that follow each other; the processes of designing, expressing and building overlap, assisted by the computer.

In so far as producing solutions for today's highly complex buildings that require different specializations has become impossible for architectural groups alone, consultant groups are more involved in the design process and at an earlier stage, and BIM—especially cloud based BIM platforms facilitates such collaboration (Ma and Sacks, 2016). Although collaboration and interoperability support later stages of design development, when the information is well structured, collaborative working methods have an impact on the development of design (Bernal et al., 2015). In this context, the most important feature of BIM is that it proposes a new participatory model for the unification of design and construction that exceeds humanistic, modern, conventional modes of design (Carpo, 2014; Idi and Khaidzir, 2018). Therefore, BIM has been called "one of the strongest manifestations of the collaborative spirit that has pervaded digital culture and technology (and upended whole swaths of the global economy) in the early years of the new millennium" (Carpo, 2014). Garber (2014) argues that BIM technologies are loyal to our conventional concept of design, in addition to all their advantages. This contemporary design mode opens up interactive possibilities of simulation, collaboration, and optimization that were previously impossible. He claims that these digital tools do not limit but extend the authorship of architects. They only need to learn the rules of this new game.

However, it can be argued that it would not be absolutely correct to describe this new architect as the only author of the building anymore, since there will be many decisions that cannot be derived directly from the architect's initial idea, and the notion of singular authorship will lose its meaning in this new collaborative production. Therefore, in architectural practices, authorship gives way to a new type of leadership.

The most prominent feature of the leading co-architect is that the architect can capture and employ information freely. In this sense, BIM enhances design processes (Briscoe, 2015). However architects should decide how to use the data in line with their design intentions-which factors to make variables, which factors to focus on-and determine the stages and the method of the information modeling process (Ottchen 2009,). In this context, the leader/cooperator architect of the BIM method is also a strategist who determines how the factors will be applied and how they will be effective on the design.

3.3. The tendencies of architectural design: From function and program to performance and optimization?

Because the information form of knowledge does not need a legitimization mechanism to have an approval in society (Lyotard 1984), BIM alters the design priorities. Prominent principles of industry/machine age architecture, such as functional programming and sterility, are replaced by targets such as performance optimization and optimal operation. The functionalist design movement emerged from the Industrial Revolution and mechanization in construction during the late nineteenth and early twentieth centuries. Conditions such as the need for rapid production to meet demands for various types of buildings led to the development of a functionalist design approach that required conceptualizing buildings in compartments. According to Gandelsonas (1976), functionalism was perhaps the most progressive ideology in the history of architecture up until then. It transcended both the complementarity of classical architecture and provided the most effective architectural language for design. However, Eisenman (1976) claimed that functionalism was not a knowledge or a way of doing derived from architecture itself. Instead of discussing the socio-cultural problems of the modern period such as the emancipation of the individual and the end of humanism, architecture had blindly followed a machine-engineering aesthetic. According to Eisenman, this attitude was a transformed continuation of the classical humanism that came along with the program. Based on this view, it can be clearly said that functionalism was an attitude that architecture followed under the influence of the modern period and can be replaced by another trend that changes the form and the way of transmitting knowledge. In this context, a similar relationship between industrialization and function/program can be seen between digitization and performance/ optimization.

Performance emerges as an important theme of the post-modern world. Scheer (2014) explained performance by establishing a link between simulation and technology. Technology reduces human vulnerability against the destructiveness of nature. Humans try to cross the physical, spatial, and temporal boundaries imposed on them by nature with technology. The ultimate goal of technology is to create a world over which we can have absolute control; one of maximum efficiency for our needs. In other words, we aim for a world where we can get maximum output with minimum input (Lyotard, 1984). Technology sets performance targets and tries to reach them. And simulation displays an ultimate environment where one can achieve all the performance targets. In this regard, performance orientation is the foundation of the simulative world. As notation moves to simulative modes in the field of architecture, performances begin to be the only goal for a building system.

Scheer (2014) underlines that metaphysics, ethics, and ontology are excluded when it comes to performance, and the only question becomes how something works well against the performance criteria. Since an important pillar of modern architecture and design is the theory arising from problems of aesthetics and meaning, it can be thought that performance and performative optimizations carry the danger of reducing the architectural experience. However, according to Ottchen (2009), the large amount of data that can be collected from different fields such as social, historical, cultural, and aesthetical, provides a new meaning. Since it is possible to make a performance analysis, the traditional methods for producing meaning collapse, and big data as a new agonistic tool opens a new realm for the designer beyond theory and nostalgic semantics. As architects can use data from many sources, they will be able to delve deeper into superficial theories and explore new possibilities.

There is an increasing pressure on architects to use both data from different areas and more sophisticated digital graphic simulation techniques in the early design stages. In this context, the effective use of data and BIM becomes characteristic of the architecture of the era (Clayton 2015; Garber

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2014). BIM's penetration of object-oriented architectural design turns it into process-oriented action. This influence changes the focus of architectural design and reveals optimization as an important criterion. Although it can be argued that performance-oriented optimization endangers the experiential depth of the architectural object, it should be accepted as a reality, and a response to this situation should be considered. Ottchen (2009), for instance, suggests that the architect should be a strategist who uses data creatively. As a result, while the architecture of verbal conveyance brought a symbolic order, the architecture of representation brought conceptuality, functionalism, and a sterile aesthetic. Simulation brings a new meaning through performance-oriented architecture.

3.4. Conclusion to the background

In conclusion, the main possible effects of the penetration of BIM into architectural practice in the three main areas within the architectural discipline can be summarized as below:

- A new way of creating thoughts and meaning comes with simulative no-tation
- A role change to being a leader/partner in a collaborative design environment
- Performance-oriented optimization in design

The office interviews were done based on these assumptions. In the following section the early reflections of the shifts in four design offices from Istanbul, Turkey will be shown.

4. Interview answers and interpretation

As discussed earlier, a modern architectural tradition is present in Turkey. Today, however, BIM methods and digital tools are used to overcome the uncertainties of construction documents and ensure that speed and efficiency increase, as in many countries.

Within the scope of the study, 5 designers from these 4 design offices were interviewed. All the interviews are conducted face to face in the designers' offices. The interviewed designers and the firms were coded as designer 1, designer 2, ... and office 1, office 2... as in the Table 4.

Table 4. Codes, companies, and positions of the interviewees.

	Designer 1	Designer 2	Designer 3	Designer 4	Designer 5
Company	Office 1	Office 2	Office 3	Office 4	Office 4
				Architect Project	Architect Broject
Position	Co-founder	Founder	Co-founder	Coordinator	Coordinator

Currently, the number of architecture firms using BIM technologies in Turkey is small (BIMGenius, 2020). The reason for choosing these four offices is that they are architectural design firms that produce work with BIM methods and have also mastered conventional methods. Since the main target of the study is tracing the change of conventional methods to BIM, expertise in both ways of working was an important factor in the selection.

The three theoretical headlines of the study shaped the interviews that are done with practitioners. Questions were asked in three groups in relation to three headings of the study in order to reveal whether the practitioners felt three theoretically suggested effects or in which direction they felt them. Approximately 12 open-ended questions were asked, 3-4 in each group. The questions opened topics about the office operation, at what level BIM is used, and the designers' future predictions about BIM. All the significant answers given are presented in the tables below (Table 5, Table 6 and Table 7). Answers were interpreted within the framework of the theoretical background of the study.

4.1. Notation

One of the prominent findings from the interviews on notation is the difficulty in switching to BIM applications. Although practitioners feel an urgent need to employ BIM methods and applications in their offices, they usually falter in the adaptation (Table 5,1).

Designer 1 (D1) states that they have been trying to adapt BIM software to their office operations for about 10 years, but that this was not possible until the last year or two. He explained that the primary reasons for the instrumentalization of BIM in the office are for making the project production stages more effective, to provide automation of the digital model, and to liberate the design process from the burden of two-dimensional drawings by using

Table 5. Featured Statements on notation.

	Simulative Notation		
1	Difficulty in first adaptation:	Need to create two-dimensional projections and the difficulty of creating them to desired levels	
2	Time for Design:	The ease brought about by BIM's automation capacities as simulations of a design	
3	Manufacturing oriented design:	Digital production of design resembles the construction in reality	
4	Expanding scope of project:	Expanding the project concept from the design of a purely physical object to the design of a process that includes the entire lifespan of a building	
5	Restriction of creativity:	Dealing with too much information in the early stages of the design	

BIM tool features that enable images to be viewed from a model on different projection planes. However, he claims that it was not possible to obtain the desired level of two-dimensional projections from a three-dimensional model in the early period of adaptation. In the interview with designer 4 (D4) and designer 5 (D5), they similarly attributed this failure to the fact that offices in Turkey cannot switch to BIM methods because they cannot obtain two-dimensional information from the model they produce in BIM programs at a level that would satisfy architects who have years of expertise in two-dimensional project drawing. According to D4, the employer's and the construction site's request for two-dimensional drawings is one of the obstacles in advancing 3D information model production. He explained that "If the two-dimensional drawing is reproduced by drafting, because a two-dimensional output at the standard level expected by the site team cannot be obtained from the three-dimensional model, then the time and effort spent on producing the model becomes pointless." Designer 2 (D2) stated that even though they actively use information modeling tools and facilities in project development processes, they print the project on paper for delivery. According to designer 3 (D3), technical drawing is insufficient to express a building from different aspects. He states that they directly share the model with other stakeholders. D3 believes when a project is put forward, not only its physical existence, but also its financing, lifetime, and usage pattern should be expressed. He claims that a simulation is needed to make such an information transfer (Table 5,4).

So, the difficulty of mastering the export of 2D projections is a drawback of BIM tools. Since the projects are still delivered in either digital or printed 2D layouts, not as info models (except at O3), high quality two-dimensional outputs are needed. In this regard, producing in a simulative environment is not internalized totally by practitioners who are used to representational notation, so, representations are still sought.

However, the simulative logic of BIM models are well understood. The comments of the interviewees show that, besides from their display capacities, the automation capacities of BIM tools are also an important factor in the transition to this simulative notation (Table 5, 2). Although different groups use the automation facilities of BIM at different levels, these capacities are utilized. D2 emphasizes that, when the project is digitally modeled, the data obtained automatically from this model provides significant time savings. While the production of project information such as zoning and material lists in conventional methods have to be written manually, one by one, the given identity of an object in the building information model accelerates the process of creating these documents and reduces errors, which increases the time for thinking about the design and generating design ideas. A similar case is expressed by D1. He stated that the ability for quick calculations of wind, light, and shade insolation conditions puts the project on real grounds and allows time for thinking of the design. The users described this situation as being rewarded with "time to design" in the interviews.

BIM tools also offer architects manufacturing-oriented design direction, which they cannot master with representational notation. (Table 5, 3) All the architects interviewed emphasized the relationship between BIM tools and construction. D1 stated that the production of the information model is similar to the construction of the building in reality and that if it is not produced correctly, the digital model also fails, just as the structure will collapse. D2 points out that the inability of some BIM tools such as Revit to produce some surface geometries means that those geometries cannot actually be

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produced. Thus, BIM tools make the structure "real". These comments address the relational data structure of BIM platforms (Eastman et al., 2011).

When asked whether the use of BIM tools in design processes restricts creativity, since it requires large amounts of information, D4 explained that Revit may limit the design to some extent, but in the early stages of design, while the initial idea is generated, using Revit is not mandatory (Table 5,5). From D2's explanations, it is understood that at Office 2 BIM tools that allow information modeling (such as Revit) are not used in the conceptual stages where the architectural idea is generated and presented, but in the development processes of the project. D3, however, disagreed with the view that too much information may pose the risk of disrupting design, saying that too much information means being open to a larger world and being able to calculate very different effects. In this context, he also stated that producing in the simulation universe established by BIM tools in design development processes does not reduce creativity.

4.2. Social role of the architect

Although the software that we consider as BIM tools was developed with a focus on modeling the design and exporting representations in different projections from this model, today, sharing the 3D design information of a building information model with other stakeholders during the project development process is also possible, and this allows for integrated project delivery (IPD) (Eastman et al., 2011). Therefore, the digital construction of a design evolves into a collaborative production.

In this regard, architects need to define their new position in an organized team on a project. (Table 6, 1). D2 stated that they do not perceive BIM as a computer program, but as an idea and a production concept; and that BIM is essentially not a single tool but a set of platforms. D2 used the "round table" metaphor for the collaborative working model of their team on a task. In her firm, BIM is considered as a process in which all stakeholders meet around a round table to manage the stratified information. She emphasized that Table 6. Featured statements on the social role of the architect.

Leadership	
Changing status of the architect:	Need to replace the phrase for the modern metaphor of "meestro" to define the architect's position in a project team
Expanding scope of building design:	Engineering problems are also considered as design problems, so engineers are expected to be involved in the project in the earlier stages
Various methods to share digital models:	Instead of sharing drawings, formulating ways to share models with stakeholders

the most important aspect of this new generation organization is "horizontal hierarchy". The most critical difference of this process from the conventional method is that the information is not left to one person to manage (Figure 2c).

Similarly, D1 states that BIM leads to a group collaboration, as experienced in their offices. This new organization prioritizes a design environment which is not the intellectual property of a single designer. What is important is that design teams from different disciplines work together and efficiently. He also stated that, while the architect can take a leadership role in such an organization, it is different from the former leadership role. D1 defined this new organization using the metaphor of an octopus (Figure 2b).

D3 underlined that the most troublesome situation in the traditional organization is the role of the head architect and explained that an architectural design project also involves "design problems" outside the expertise of architects. D3 sees the engineering problems of a project also as design problems (Table 6, 2). Engineers usually analyze the system in the direction indicated by the architect in conventional workflows. However, in the BIM workflows at O3, engineers are expected to be involved in the project at the early design stages. So, in as much as they comprehend the design through three-dimensional digital objects, they can engage with the design problems. D3 stated that the architect can no longer be described as the maestro in this workflow, but as an orchestra member at best, like a pianist, and that, when the score is taken up by the string section, he should stop and wait for his part (Figure 2c).

D4 explained that to produce optimally integrated projects with BIM, they share their models in IFC format for static calculations. Engineering


Figure 1. Workflow types of project development.

Table 7. Featured Statements on design tendencies.

	Performance					
1	Design optimization	Using BIM models to analyze and optimize design according to some performance criteria				
2	Alienated forms	Raising the level of constructability increases clients' demands for alienated forms that are not achieved through architectural expertise				

groups usually open this model in Tekla to produce their own models by taking architectural models as a reference and then send it back to the design team (Table 6, 3). D4 explained that this method is very useful in the development of the project, and added that coding the design information in a simulative BIM environment enables better communication with the consultant groups. BIM models increase the mastery of 3D among the consultant groups on the project, and thus, allow a democratic collaboration among all the stakeholders in the project.

However, it is also underlined by D4 that "today, despite all its benefits, it is not possible to establish a horizontal organization between architects and consultants in small-scale projects. Setting up such a control team also incurs a cost on the employer's side. For such a control mechanism, many people such as a BIM manager or a quality control specialist should be assigned. Small companies do not prefer to establish a corporate structure for a single project. Instead, the preparation project as a whole, with its coordination and solutions, is left to the architect."

In this regard, it is clear that producing projects in the horizontal organization of the BIM method is only widespread in large scale projects but may become a habit over time. If sharing information through BIM models becomes prevalent, the architect may be completely relieved of the burden of project coordination.

4.3. Design tendencies

A feature of BIM notation is the goal of gathering the maximum level of information about the project on a single model. The fact that all the data belonging to a project is stored in one model also makes the design analyzable against various performance criteria. The important finding related to performance is that all the practitioners' statements show that they analyze and optimize their model according to various performance criteria.

D1 stated that they use lighter BIM tools or BIM applications that contain relatively less information than a design tool, with the aim of analyzing the model for performance criteria such as lightning, shading, and wind exposition, and to create mass studies accordingly. Moreover, D1 related that they can make cost estimates from mass analysis by rapidly entering information into the models at the early stages of the design, thereby making a difference (Table 7,1). D2 stated that analyzing tools are an important part of their designs, especially in considering environmental factors. She explained that these data are determinative on how the building is placed in the area at the earliest stages of the mass design. D4 and D5 stated that the information model is also widely used in professional analysis by simplifying it to shorten the processing times or by adding new information when necessary. They share the model with consultancy groups who are experts on subjects such as lighting and/or acoustics to conduct a professional analysis of whether the project meets certain standards, and the results are reported (Table 7,1).

The decisions that used to be made intuitively by the architect in conventional methods depend gradually on

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the data obtained from the analysis of the offices that use BIM tools. D3 emphasized that the main reason for using BIM is performance-oriented targets. He believes that performance goals should be a primary preference in an architectural design, and explained that performance is always a priority when performance criteria and aesthetic preferences conflict in his design approach (Table 7,1). He underlined that when the buildings do not perform well, they cannot avoid making interventions that the architect does not anticipate. On the other hand, according to D2, these analyses do not draw a very different conclusion from the intuitive ones, but strengthen the validity. According to D2, it is inevitable that optimization concepts will come to the fore in a world, in twenty years, with a population of 15 billion people. She underlined the need for concepts such as optimization when the project needs to be democratic and accessible to everyone(Table 7,1).

D5 underlined that, with the development of construction technology and BIM technologies that allow more information to be transferred, many forms that could not be done in the past could be constructed, and that this has evolved architectural design into a showcase (Table 7,2). This interpretation of D5 parallels Lyotard's argument that claims that since "a universal metalanguage principle has been replaced by the principle of plurality of formal systems in the information age, things assumed as a paradox or even a paralogism in classical and modern science, can find a new persuasive power in any of these systems and obtain the approval of the community of experts" (Lyotard, 2014, p.85).

5. Discussions

The statements clearly show that offices initially resist adapting to BIM methods because it is a new, simulative form of design information. However, once they have adapted, simulative tectonic models that produce fast, automated design information have enabled early users in Turkey to use the data for rapid analysis. To the extent that they can dominate a certain level of information, novel information modeling tools have allowed architects to save time on their projects. However, the phrase "saving time" shows that, although offices employ these models for some analysis, they still save time for the early stages of a design for which they mostly rely on intuitive, conceptual representations to generate the initial idea (or the meaning) of the design. Designers prefer more abstract representations in the early stages of a design because BIM requires a high level of information, and thus resembles a real built object. However, this does not mean that BIM tools should not be considered as a design tool. BIM constitutes an important part of the architectural design process to the extent that it is used to produce and develop architectural solutions. In the O3 example, BIM tools are employed in all stages of the design. Based on D3's comments, it can be said that the transition of the architectural notation from representation to simulative information models brings a new design method in which the designer manages huge amounts of information. This extends the scope of the architectural project concept from the design of a purely physical object to the design of the entire lifespan of a building.

In the context of changing the social status of the architect, although the offices apart from O3 do not see themselves at the ideal level for integrated project delivery (IPD) with BIM tools, the use of BIM tools and data sharing in a project has already affected the position of the architect in a project organization. All of the interviewed architects were aware of a shift in the author role of the architect and attempted to define the new organization with metaphors such as "octopus", "round table" or "orchestra member". They also stated that the involvement of the consultant groups in the early stages of the project would lead to a more effective and lean design. Of the offices interviewed, O3 was the only one that has implemented BIM tools and methods at a level that can provide IPD literally. However, O3 was able to do this by incorporating all the other disciplines. In as much as BIM increases the level of cooperability, the architect is placed more in a leader/project partner position. However, the loss of authority in these processes does not mean that the architect is devalued. On the contrary, it can be claimed that their word is better understood and becomes more valid and valuable due to the transparency of the process. It can be claimed that producing projects according to the horizontal organization of BIM can possibly relieve the architect completely of the burden of project coordination, which will be done automatically by the sharing of information. In consequence, BIM methods transform the organization and accordingly transform the role, position, responsibilities, and business tradition of the architect. This transformation has begun, albeit to a small extent, in Turkey's architectural environment. However, it cannot be said that there is a complete shift since offices work in different organizational structures for different types of projects.

Regarding the design tendencies, BIM enables the design optimization for performance criteria. In all four offices these features of BIM are used and the final design is optimized to some extent. Although this may pose a risk of losing the authenticity of the design, it also brings a level of democratization. Besides, the level of constructability brought about by BIM risks diminishing the importance of the architectural design knowledge inherent to architects and achieved through formal education. As a result, even though the data from the analysis made in the advanced stages of the project do not have a major impact on the design, for good or ill, performance is increasingly becoming a prerequisite for architectural design. While buildings were thought of as "a machine to live in", today they are becoming shells adapted to environmental conditions. In this context, it can be said that the building form, which has followed function for a period, now pursues the target of meeting certain performance criteria in aspects such as material, structure, organization, and configuration performances. As a result, the design becomes gradually performance oriented, as seen in the design offices form Istanbul, Turkey.

6. Conclusion

The primary and most substantial result of this study is that BIM should be understood as a new form of knowledge in architecture. Secondly, it was shown that this change in the form and transmission mode of knowledge affects architectural practice.

First, due to the agency of BIM and its complementary technologies, a new type of architect is emerging who can translate design into data and can thereby engender meaning in a simulative environment. In the offices of the interviewed designers, although architects use the advantages of digital simulation mostly to shorten revision and documentation processes, there are those who complete whole project phases in BIM. These groups experiment with a new type of digital tectonic creativity in simulation. Secondly, BIM presents a collaborative environment where the interdisciplinary development of a project is possible. In the offices of the interviewed designers, architects use this opportunity to involve engineering groups in the project at earlier stages. This way, they aim to minimize the mistakes regarding the technical requirements. As a result, a new type of organization emerges. Architects who are interviewed for this research described this organization with metaphors like "octopus" and "round table", or the position of the architect as an orchestra member. It is clearly observed that in these organizations, it is not the authority but the traditional contractual position of the architect that is eroded. Finally, the building's performance emerges as a crucial design criterion for the future of design. In the interviews, all the architects mentioned that in both the early and late stages, the 3D information models are subject to several performance analyses. Even though these analyses do not create very different results to the architect's initial intuitional decisions, they are gradually becoming the de facto steps of design, and affect the direction of architecture.

In conclusion, BIM is the new method of architectural project development that affects architectural practice. Therefore, architects cannot neglect its listed impacts and behave as if BIM is just another computer aided design

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tool. BIM, as a new form of design knowledge, should be well understood and instrumentalized accordingly for an enhanced, enriched, and advance architecture.

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How to live in a flat: A study over William Heath Robinson's representations on life in modern houses

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Abstract

Radical changes have taken place on housing under the influence of modernism. These changes drove the writers, sociologists, philosophers, artists, architects, and designers of the period. Today, urban growth and narrowing housing spaces have increased the research on houses again. Upon closer inspection, contemporary houses show that the effects of modernism still last. Therefore, it is essential to examine the productions and discourses on housing to produce new, practical, and realistic spaces. This study examines modern dwelling through the illustrated book How to Live in a Flat by William Heath Robinson and K.R.G. Browne in 1936. As critiques of modernism, the satirical images in this illustrated book are still valid today to understand modernism's effects on the dwelling.

This paper deals with the development, symbols, interior features, and furniture of modern houses. The identity of the modernist house was questioned through this book by using phenomenological research as a qualitative research method. The paper examines modernist interiors with a comprehensive literature review. Subsequently, a discussion was held on future predictions by using inductive reasoning. These images offer a considerable amount of data on modern dwellings and decrescent living spaces from modernism until today. As a result, the study argues that examining the previous works will prepare a practical ground for future productions instead of predicting or defining a new residential life. In light of the data obtained, the study concludes that designing by evaluating the data of everyday life should be accepted as a prerequisite.

Keywords

Dwelling, How to live in a flat, Modernism, Modern houses, William Heath Robinson.

1. Introduction

The concept of dwelling has been a significant factor that has various meanings for designers in different periods. Over the years, designers have produced utopias about how houses will be and predicted the life in them. How to sit, eat, work, come together at home are still a matter of research. Homes are in direct contact with people. It is what makes them more than a design object. The relationship between everyday life and homes is an essential topic for designers. Houses form the core of life in cities. Accordingly, utopias affect housing both in terms of concept and design. This situation has gained a new dimension with modernization.

Along with modernism, the concept of dwelling has become an idealized element and a product. As Corbusier (1993) mentions, the opposite situation is not to show interest in what makes up people's lives. However, modernization and home-based productions create a dilemma within themselves. Although the house stands at the center of the discussion, life at home -consciously or not- is excluded.

Objectivation in city life emerges as one of the most prominent results of modernism with industrialization (Talu, 2012). Through modernism, public life is rationalized completely, and housing was at the center of these ideals. Through this objectification, life at home has taken on a different dimension. Houses began to be perceived as photogenic objects, and everyday life did not fit into this fetish image (Garip & Celik, 2020). Yet the house is the body of actions. It meets the physiological needs of people as well as business, hobby, and spare-time activities as a center of behavior (Després, 1991). And the utopian ideas generated are suggestions for this ideal life. The modernist period experiences this contradiction within itself. While the designers idealize the house and life in it, they also exclude the existing state of daily life. Yet, every future prediction on housing also tries to predict life inside the house. Every design act on housing is political and reveals a vision of life.

Architects are not the only ones who made intellectual and critical future predictions on housing. Various fields of expertise are produced for dwellings due to their social nature. It is essential to study and understand these productions for the design discipline. Just as it is possible to examine the photographs of Charles Marville (1813-1879) or the caricatures of Honoré Daumier (1808-1879) to understand the 19th century Paris, it is possible to look at the productions of the period to examine the approach to home in the modern period. Alternative approaches help designers understand housing and domestic life through different perspectives.

This study aims to define modern housing through the illustrated book "How to Live in a Flat" by cartoonist William Heath Robinson and writer K.R.G. Browne. The illustrations of William Heath Robinson present a satire of modernism by documenting what modernity has brought to social life. The research examines the development of dwellings in the modern period through symbols, interior features, and furniture. It contributes to the literature by examining the influence of modernism on residential life by focusing on the caricatures of the period. The study is notable in that it consolidates architecture and satirical caricatures within the framework of modern housing.

2. Method

The identity of the modernist house was questioned through the illustrations in How to Live in a Flat using phenomenological research as a qualitative research method. The paper examines modernist interiors with a comprehensive literature review. Subsequently, holds a discussion on future predictions by using inductive reasoning. The purpose of the study is to analyze these data to form a basis for future housing. Lastly, the article offers a doctrine in light of these critical productions instead of a positive or negative comparison about the modern period. The study suggests that deriving and understanding the idea behind these interdisciplinary productions could help designers create better-living spaces.

Six cartoons were selected from the book How to Live in a Flat to examine Robinson's point of view and predictions in detail. The determinant in picking these drawings is that they provide the most spatial data. Moreover, the article proceeds through the general approaches in Robinson's book. Based on these six images a general discussion was conducted. The study examines the illustrations under three main titles. The first title is about the structural features of modern houses and the situations that occur accordingly. The second main factor is the shrinking spaces and their effect on the interiors and their production. Finally, the third title examines the furniture productions. The gathered data is analyzed with a binary examination over the period analysis and future projection. The data ended with a table to observe the complete analysis of the period altogether.

3. Background 3.1. Modernization of interiors and residential life

According to the United Nations, 7.78 billion people live on our planet in 2021. In 2030, this number is expected to increase by more than 1.2 billion. As stated in the United Nations "Sustainable Development Goals" (SDGs), 68% of the world's population is expected to live in cities in 2050 (United Nations, 2017). In the meantime, the population keeps increasing day by day. The settlement patterns and residential life in cities are also changing. 10 more cities will become megacities, and there will be 43 megacities in the world by 2030 (World Economic Forum, 2019).

With the increasing urban population in megacities, the absence of urban areas for horizontal construction, and the difficulty of economic access, residential areas decrease. Along with these changes new lifestyles emerge. A way of life in which more household goods and services are shared. Smaller living spaces are becoming the norm. Concepts such as micro-living, tiny houses, and co-living are promoted for a life in standardized, cramped houses. However, this situation is nothing new but a part of the historical process.

Since the 19th century, modernism's function-oriented, machine-like space productions were designed for industrialized and crowded cities. Modern principles automated space and spatial activities with a functionalist approach (Greenhalg, 1990). Modernism constructed a new life ideal and these principles continue to affect life today as a result of industrialization.

Berman (1988) defines "being modern" in 'All that is Solid Melts into Air' subtitled 'The Experience of Modernity as follows:

"...To be modern is to find ourselves in an environment that promises us adventure, power, joy, growth, transformation of ourselves and the world and, at the same time, that threatens to destroy everything we have, everything we know, everything we are. Modern environments and experiences cut across all boundaries of geography and ethnicity, of class and nationality, of religion, ideology: in this sense, modernity can be said to unite all mankind. But it is a paradoxical unity, a unity of disunity: it pours us all into a maelstrom of perpetual disintegration and renewal, of struggle and contradiction, of ambiguity and anguish. To be modern is to be part of a universe in which, as Marx said, "all that is solid melts into air."

This paradoxical standardization has led to the transformation of the built environment with industrialization, rapidly developing technologies, and new production techniques that created new sociological effects (Berman, 1988). Life has become systematic with industrialization and mechanization, and architectural space production has also been rationalized with this approach.

According to modernism theorists, the modernization process since the 19th century impacted society and individuals towards rationalization (Tanyeli, 2013). Tanveli (2013) states that modernism is based on the "illusion of a loss of form" whereas the city has never had a form. According to modernism, the city once had a morphology, but this shape has deteriorated over time. Modernism aims to reform city life (Tanyeli, 2013). However, space and society are in a dynamic relationship, and this relationship puts cities in continuous motion. Urbanites tend to change the imposed within the framework of the requirements of urban social life.

The influence of the built environment on social life politicizes it and makes it a research subject for many fields. In 1516 Sir Thomas More published Utopia. Thus, he implicitly criticized the

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society of his time, igniting the literary tradition that defines the ideal life for the future, both for the Renaissance and the times we live in (Meyerson, 1996). Italian architects Leone Battista Alberti and Filarete sparked a utopian tradition of designing the ideal city (Meyerson, 1996). Social utopias aim to capture the 'better' within their framework. Since then, various utopian ideas have been produced and discussed in different periods. The initiation of these debates on social problems is critical for cities, architecture, and spatial production.

There were also discourses on housing in conjunction with the urban utopias that define the ideal urban life through modernization and aesthetic sterilization. Housing was the foundation of this idealized urban life. The idealized new world has accordingly transformed residential design by focusing on rational design and functionalism. Architects have used exhibitions to present their housing designs and to "educate" society. They exhibited their proposals on modern housing with architectural exhibitions such as the International Exhibition of Modern Decorative and Industrial Arts in Paris in 1925 and the Stockholm Exhibition in 1930. "The Pavilion of the L'Esprit Nouveau" by Le Corbusier and Pierre Jeanneret was exhibited in Paris and created a remarkable impact with its roof terrace and fully industrially produced furniture (Ashby, 2017).

The utopian dream of modernity, which presents the ideal of realizing the house as a flawless, minimal, and functional machine, does not meet the personal needs in real life. Modernism emphasizes a design perception that prioritizes visual quality. Heidegger, Foucault, and Derrida argue that modernism strengthens its negative aspects by increasing the dominance of visuality in the historical process (Pallasmaa, 2011). However, there were various predictions in the search for an ideal city and home life. In contrast to the sterile approach of modernism that denies the customizability of the private space, there have also been approaches that glorify individuality. They define the dwelling and the city as a whole by randomness and chaos. While some of these are utopian discourses that remain

on paper, some of them, like Le Corbusier's modernist productions, have been realized in different scales from housing to the cities.

There are diverse periods when it comes to modernist houses and modernists approaches to housing. Future predictions have put forward distinct views about modernist architects and home life. It is necessary to ask the following question to understand the architecture of a time: Who was in the world at that period? (Yürekli, 2010). This question is also valid for modernist times. Industrialization-related issues and the need for new housing have placed housing at the center of discussions and productions. It is possible to say that the basis of modern architecture is tuberculosis, not seeking a new style (Yürekli, 2010). Housing and its design have begun to exist in the lives of not only wealthy people but everyone. Le Corbusier (1993) states the following on this issue; the most rightful and primary occupation of every settled society; is to place people in houses. The dilemma of modernism begins here. Modern ideals put the dwelling at the center of the design and discussion and tried foreseeing daily life. However, by doing this, life at home is marginalized. In the following periods, this approach has changed and transformed.

Architecture is always a dream and functionality, the expression of a utopia, and a means of comfort (Barthes, 2008). Based on this view, it is possible to see that every architectural production is in this duality. While the modernist era puts the house at the center of the discussion, it excludes human life at home. Within this dilemma, each designer has taken different approaches. This exclusion may appear as a visual representation of everyday life or as neglect of life. However, this situation may also exist as the exclusion of life at the design phase. The home is isolated from human life. This situation gives rise to the desperately desired ideal home (Talu, 2012).

This duality can be seen, for example, in the designs of Frank Llyod Wright. He communicates differently with the users. The motivation to design every single domestic item excludes the ability to personalize and own the place. The house becomes a fetish design object.

According to Corbusier (1929), a house is a machine for living in. In Corbusier's view, the elements of the house should be designed accordingly. Visuality is the basis of modern ideals. The sense of sight occupies a critical place in the writings of modernists. The privilege given to the eye in early modernist theory is revealed in Le Corbusier's words: "Only if I can see I am alive, I am an inveterate visual and I will remain, everything is in the visual, to understand it must be seen with clarity. I urge you to open your eyes." (as cited in Pallasmaa, 2011). These approaches provide context for ideal housing research and critical texts (Talu, 2012). For example, Smithson's most popular projects, the house of the future, were the most distinct ones. Ordered by the Daily Mail to suggest a future suburban living space, this sample house was full of ingenious little gadgets (such as a shower-hairdryer-beacon combination). However, the curvilinear plastic form inspired the principle of adopting new technologies to architectural structures and science fiction films of the time (Foster, 2013).

Modern interiors changed the way people cook, sit, study, sleep or arrange their furniture. The style of the furniture determines the interior of the house unambivalently. Various designers produced furniture in their design style during the period. In this context, Mies Van Der Rohe's Farnsworth House is an example. In this open-planned house, the furniture defines the interior with clear lines. It is unique and clear from the design of the seats to their placement. Ideal integrity is sought in the design. Many other modern dwellings have the same integrity aim.

Furniture is used as an element to determine the interior and lifestyle. This situation is also valid for the different functional spaces of the residence.

Similar approaches have been tried for kitchen design in various modern homes, and written and visual media have been produced for the ideal kitchen. In each production, there are sterilized forms of daily life adapted to this mechanic approach. Kitchen proportions were designed in the most appropriate way for human access. It is the case from bathroom units to every single item used in the kitchen. In these wholly designed 'functional' houses, the existence of actions disappears. House becomes a sterile object. It is reflected in the photos as well. Although there are almost no people in the photographs published by the architects, there are objects that do not belong to the houses but are left there on purpose (Altınyıldız Artun, 2012). Photographs and drawings as representations of the modern house are the continuations of this objectification. Life at home is represented unlike what it actually is.

Not just architects but other disciplines have also produced ideas about the political aspect of the modern dwelling and its impact on social life. A house is a tool for every area of the design that feeds on these elements. The controversy created by the modern house influenced the critical illustrators and comics of the period. Twentieth-century intellectuals produced counter-utopias and cautionary panoramas, perhaps at best when the caricature was inherently cyclical rather than the best (Meyerson, 1996). They reflected their critical view of the current situation with caricatures and cartoons.

3.2. Caricatures, satire and architecture

The relationship between architecture and comics/caricatures has existed for many years. The relation between these concepts has been featured in many books, media, and academies in America and Europe. Academic interest in the history of American editorial cartoons, comic strips, and graphic novels has exploded in recent years in the United States, with more universities offering courses on the subject. Scholars in France, Germany, and Italy were among the first to pay attention to comic books critically (Roeder, 2008). In Europe, on the comic page, architecture has long been an important feature. Winsor McCay provided readers of the weekly Little Nemo in *Slumberland* with a complete compilation of modern American styles in the early decades of the twentieth century (Labio, 2015). The interiors have a significant role in these comics. Buildings have also played a vital role in the history of Franco-Belgian comics, particularly in the Twentieth Century's last decades (Labio, 2015). The prominence of architecture in different mediums attracted the attention of many various institutions and architects back then. The architectural movement in Franco-Belgian comics was strong enough that the Institut Français d'Architecture held an exhibition called *Attention Travaux! Architectures de Bande Dessinée* in 1985, which featured hundreds of illustrations from classic and contemporary European comics (Labio, 2015).

Yet what are comics and caricatures? Is it an art form? Or is it a narrative? The most recent detailed study of caricature was conducted by art historian Ernst Gombrich and psychoanalyst Erns Kris. They perceive a clear distinction between caricature and comical art and, portrait caricature did not exist until the end of the sixteenth century (Smith, 1990). In 1985, with Will Eisner's book Comics as Sequential Art, perceiving comics as art in academic literature began. For Eisner, comics were sequential expressions with an artistic and literary aspect (Babic, 2013). Yet nearly everyone at a recent comics symposium at the University of Chicago wanted to avoid declaring comics to be an art form. Most of the people who drew and wrote comics stated that they had no desire to be lumped into this group by academic critics, while the majority of academic critics also stated that they had no such intention (Gunning, 2014).

While the discussion of 'art or not' includes many different factors, it is similar to architecture and design in this aspect. Architecture also finds itself in this discussion in many various states. So why is architecture significant for this field? Comics can practically map a life because of their spatial rules. It can depict a person's life on a single page (Chute, 2011). This state places comics and cartoons at an essential point for architecture. On the contrary, architecture and design are also relevant for this field. With the design revealing a story, these can be considered as two areas that feed off each other. The fact that diverse fields tell about life and its problems allows people of that period to conjecture the situation from different perspectives.

A film, a drawing, or a cartoon presents it to its audience by reconsidering the present or the future. This impersonated form offers the opportunity to revisit the subject, think, and criticize from different perspectives. The satirical feature of the caricatures paves the way for new solutions and discussions by exaggerating reliable problems. However, this potential of the caricatures brings its risks. Modernism, which is a significant period in the intersection of architecture and caricature, is an example. The potential of the caricatures for architecture is considerably high. In addition, it is an indisputable fact for that period that caricatures and cartoons had a high impact on mass media and society's perspective on architecture.

When architectural tendencies coupled the Avant-garde's figurative inquiry with the logic of standardization and industrial production in the 1920s and 1930s, Central Europe underwent a significant revolution in the history of housing types (Neri, 2019). The suddenness and sharpness of this change re-created the typical house structure. The aim was to introduce and adopt people to this new model. But the fact that this change was quite different and sudden, drew a reaction. First, modernism's visual accumulation resulted in a resurgence of cultural stereotypes. This situation highlighted the image as a social construct more than everywhere else (Ratouis, 2019). In this process, the media had a noted influence on the popularization of modernism but, the new wave of urban construction, both small and large scale, quickly revealed many paradoxes and flaws (Neri, 2019).

Modern architecture became the focus of many different critiques. The satire of existing problems with this aspect also fueled the current media attention. Several artists created drawings on the subject. This diverse yet organic group of current cartoonists produced a steady supply of skits for the satirical, specialist, and even mainstream newspapers, many of which highlighted the primary influence of the new architecture on society and often did a better job documenting it than other types of critics (Neri, 2019).

Simplicissimus, a satirical German weekly magazine, published a Wilhelm Schulz cartoon titled "Neues Wohnen" (New Living) in 1929, illustrating the

psychodrama of a woman frustrated by modern architecture's extreme minimalism (Neri, 2019). In these cartoons, the reflections of modern architecture on the interior and minimalism are exaggerated. The caricatures draw attention to how life in the house is interrupted due to the Modern approach.

From this sudden arrival of modernism, England took its place in the period. In England, where the housing typology and life is quite different from what modernism offers, the modern interior began to be the leading element of discussions and caricatures. It took its place in many various media mediums in the Modern period and later. Osbert Lancaster, a cartoonist, author, and critic, published English architecture and interior design in the Architectural Review, which was reprinted as Progress at Pelvis Bay (1936) Pillar post (1938), Home Sweet Homes (1939) (Rosso, 2019). He drew a caricature in 1938 at Pillar to Post named Twentieth-Century Functional. He drew the dwellers too large a scale to emphasize the doll's house quality. Later Lancaster's satirizing style has been a regular source of humor in Punch Magazine (Powers, 2019).

One of the most important works of the period was How to Live in a Flat by cartoonist William Heath Robinson and writer K.R.G. Browne. The book is a sarcastic guide on how to live in modern times. Robinson's predictions about the house create an opportunity for discussion in a different dimension.

4. Findings: Reading William Heath Robinson's modernism representations

Future predictions, productions, and criticisms on housing maintain a significant role for design culture and new creations. It is required to understand and examine these productions properly. It will allow designers to perceive that period and to create new approaches in future productions. According to Lefebvre (2015), a utopia can be surprising in implications and consequences. Which places will be socially successful? How are these found? By what criteria? What times and rhythms of daily life are recorded and written in these spaces that are suitable for happiness? It is what is considered fascinating (Lefebvre, 2015). In this context, William Heath Robinson's illustrations are both a criticism and a future prediction/utopia. While criticizing the modernist period by satirizing it, he creates new productions. The design potential and critical perspective of these productions are valuable and influential. In *How to Live in a Flat*, Robinson deals with various components of modern houses.

Born in 1872, British cartoonist, illustrator William Heath Robinson was published in popular magazines as an illustrator and humorous artist in the early 1900s. Having studied at Islington School of Art and The Royal Academy Schools, Robinson continued his career as a cartoonist, which he started with the desire to become a landscape painter. Robinson, better known for his strange, complicated machine drawings, has produced images that satirize chaotic events that happen randomly in human life by chance. He started publishing the "How to ..." series that began with 'How to Live in a Flat' in 1936 (Heath Robinson Museum, 2021).

How to Live in a Flat consists of ten chapters. In the introduction section, the house is depicted strikingly with the evolution of the flat. The economy of space section addresses the minimum space-maximum function approach of modern housing critically. The furniture and fittings section envisages the multifunctional furniture of the time. Pets and pets corners question the place of pets in modern houses. The section on sports and social amenities deals with the social life envisaged by modernist housing and urban life. The book continues with converted houses and service flattery and bungaloid sections. It ends with the darker side of a flat life and tailpiece sections. It approaches the function-oriented state of modern housing that excludes daily life with a strong satire. In parallel with economizing the spatial needs of individuals, there is a reduction according to functions. While functions such as sleeping, eating, and sitting are highly valued, the given importance of vacation, leisure time, and visiting are reduced (Helle, 1996). The drawings are a representation of criticism of this situation.

How to live in a flat: A study over William Heath Robinson's representations on life in modern houses

4.1. Icons of modern housing

Above all, it would be to the point to mention the symbolic structural features of the modern house. These features are very much depicted in the book. It is an impartially new approach for this period. In addition to living together in 'apartment' life, elements such as flat roof and metal construction, which are the physical elements of modern housing, have also been included in residential life. In the rapidly developing period, the process was interrupted in most places by the Second World War. After that, a period of rapid reconstruction began without even breathing. As a result, there was no time left to organize and deepen the search for solutions for the 20s. That was a shortcut and countless unmolded, reduced and distorted copies of emerging forms of modern architecture were produced (Fischer, 2015).

With the effect of these rapid productions, the modern house found itself in the middle of many copies before it was fully developed. Robinson discovered this situation clearly and approached it critically in his book. He had an approach that also encounters the idea of modernism; the claim to offer everything. The sections were written in a marketing style with a modernist approach as if the houses are on sale for potential buyers.

There is a solution to every problem in Robinson's modern houses. He criticizes what modernism cannot provide with the solutions in his ideas. Flat-roofed buildings and social housing are mentioned in the book several times. The drawings describe every action and activity in the home circle. The reason behind it is to satire the drive of the modern house to predict life. There are many examples in the book about sports that dwellers can do on a flat roof. These are visuals that critically approach man's relationship with nature. He illustrated the activities such as hiking and tennis on the rooftop, which does not fit its surroundings (Figure 1). The modern house also provides sports in city life. Even though they are out of context, there should not be even a single point where life is not predicted; that includes sport activities.



Figure 1. Robinson's representations of "The roof garden" and "An artistic way of hiding an unsightly view" (Robinson & Browne, 1936/2014).

In the second illustration, the problem of this relationship with nature continues (Figure 1). The dwellers always want more, and Robinson portrays precisely their desire for natural life when living in the city. This desire is primarily taken care of by providing the visuality as in this image. Trees are on a platform connected to the buildings where the dwellers can see. Robinson portrays the distorted relationship established with nature. In the book, people who live in modern dwellings dream of returning to nature. But for this, there is a nature house proposal that modern architecture creates. Robinson proposes tiny caravan houses. The idea of returning to nature is offered to the wealthy urban dwellers. Houses in nature are designed and presented for those who are bored of the city as objects of desire. However, designs do not compromise comfort and luxury. Urban dwellers work and try to continue their lives in their pretty, overpriced houses in the city center. While doing this, the 'nature house' fantasy is also presented to the city dwellers. Remarkably, this cycle has continued similarly for hundreds of years. Robinson produced this work decades ago, yet it gives readers the chance to question the current situation.

4.2. Interiors

Another striking point among Robinson's drawings is his foresight and criticism for interior spaces. The book examines life in the shrinking residential areas and the productions proposed by modernism within the framework. Robinson criticizes the idea of seeing the home as a machine and these functions attributed



Figure 2. Robinson's representations of modern kitchen and a flexible room (Robinson & Browne, 1936/2014).

to the spaces through satire. The first of the striking images is about the kitchen space, which many architects have drawn on and produced examples. Corbusier's famous 'machine simile' mentioned in the background section and his approach to areas before-mentioned as kitchens are examples of these productions.

In modern housing, the kitchen has become one of the main issues of the house. It has been the core of the arrangement of exemplary life. In this ideal modern life, the kitchen will function like a machine that will "help women" be more involved in social life with the design that facilitates household chores (Moma, 2011a). There is an ideology behind this to change social life through the use of design and technology. The iconic "Frankfurt Kitchen" designed by architect Margarete (Grete) Schütte-Lihotzky is the most striking and principal example of modern kitchen design. Frankfurt Kitchen is produced like a laboratory or factory, designed with contemporary theories such as efficiency and hygiene (Moma, 2011b). The kitchen is encouraged to be designed in the most "functional" way, based on human proportions. Robinson also criticized these elements and produced his kitchen design. Each component is adaptable for usage in the small kitchens in Robinson's design (Figure 2). This kitchen provides maximum performance with the different levels and stairs. Daily objects are hung or attached to the place. The broom finds a position on the ceiling in this scenario. With this image, Robinson discusses how close these predictions are. Space is not a machine. It is a living space.

And life in this area does not work as predicted. The drawings reflect the existence of daily life. The elements rejected by modernism find their place in Robinson's illustrations as well as presenting their existence. The everyday life units such as the child in the kitchen drawer and floating cans are strikingly included in the scenario. Another concept that modern residences ignore in both representations and life predictions stands out in the second image: guests.

In modern productions, attention on roles such as guests is reduced to a particularly profound level (Helle, 1996). Robinson freshly approaches this situation with a critical eye. In addition to the household, there are guests as everyone experiences. In the "sterile" reality of modern life, this concept of being a guest is not common in representations. The house is dismantled from everyday life. The attributed daily life does not reflect reality. Either it is a representation of a sterile frame about the home, or it is presented with the perfect family living in the house. But a 'guest' coming to these images from outside is a stranger.

In his drawing titled The spare bedroom, there is a satire about the dwellings not designed for the guest (Figure 2). The house expands and transforms impossibly. It has an extra room with furniture inside. Robinson's ideas about the life and interior pattern of modern housing are critical. It is necessary to perceive the space and the possible actions in it accurately. Rather than classifying these actions under the name of a function, it reveals the necessity to think of them as elements that take care of space and life. In alternative scenarios, everyday life does not conform to these predictions. It should be the priority of a designer to think about the daily life elements. And construct their designs accordingly.

4.3. Furniture

Furniture and its new production methods have a significant position in the modern period. It is also a notable matter in Robinson's illustrations. Tubular-steel furniture started to be produced with the new production techniques that emerged during the period. This advanced furniture style adapted aggressively to the modern world. Designs tried to achieve the comfort and good living ideals of the modern age by these new forms and materials (Sparke, 1990).

There are many illustrations of steel furniture. Tubular steel furniture was one of the most eye-catching modern design innovations. The new metal furniture was odd—even repulsive—to the general public, particularly in home settings (Rosso, 2019). Robinson critically approaches this situation. In the first image, he reconstructs tubular-steel furniture with this new production technique. He designs it by using a single piece of steel and points to the contrast by portraying highly dressed people as users (Figure 3).

In this period, the visuality and production methods of furniture gained interest. Robinson criticizes the uselessness of these pieces of furniture. He complements the fact that everything can be washed and collected at the same time by these easy-to-clean products. It is also a reference to the "purity" obsession of modernism. These cartoons not only revealed the metal tubes' initial use, which was mainly as gas pipes, but also the raw nerve of their application in furniture: their coldness, not merely in terms of temperature (cold to the touch), but also in terms of looks (cold to sight) (Neri, 2019).

In the second picture, he criticizes the lack of space in modern houses and increasing work intensity by combining all functions in one piece of furniture (Figure 3). The user who is satisfied with the benefits of modernism continues to work during his bath. This representation reflects the bathroom combined with the work area and criticizes the shrinking spaces of the period. However, there is a diverse life in these 'functional' spaces. It is seen that the critical approach of this furniture preserves its validity when considered in today's framework.

The effect of modernism and its aftereffect on furniture is an undeniable fact. In the current period, the small residential areas and the spatial elements encoded in that space are intertwined. Furniture designs also reflect this condition. As an example from the current period, the usage areas have changed with the pandemic, and each piece of furniture has had to fulfill different 'un-



Figure 3. Robinson's representations of tubular-steel furniture and a multi-functional desk (Robinson & Browne, 1936/2014).

able to serve' functions. At this point, the "businessman desk" (Figure 3) with this critical approach where multiple functions are combined is a problem that is also present in today's residences. The furniture that could not change or transform and provide intended functions had to face these changes. It is vital that the furnishing produced in the new period can serve the small residences and spaces. It is essential to focus on the experience rather than functions and to consider enhancing that experience.

5. Discussions & conclusion: What is learned from 'How to Live in a Flat'

In the light of literature review and findings, the study discusses modern houses as a new way of life, production, and functionality with three main components. These are; building-environment relationships, interior spaces, and furnishing. These core components of modernism changed the way of the discussions over housing. The article analyzes the modern productions through illustrations in How to Live in a Flat by William Heath Robinson and examines the drawings under three main titles; building-environment relationships, interior spaces, and furnishing (Table 1). The table shows the derived data about the modern period, its findings, and flaws through Robinson's drawings.

Architects tried to foresee every element of modernist era dwellings and life. They have designed "multifunctional", sterile, visually appealing objects that did not usually fit the daily needs. The study argues that these idealized productions and their social and architectural effects can be read through satirical drawings of William Heath Robinson.

First of all, the structure-environment relationship was taken into account. Rapid production and urbanization make it essential to reconsider the relationship with nature. Robinson criticizes these elements in his drawings. He satirizes the inadequacies of the struggle to create socialized houses with unmatching activities on the roof, such as tennis and hiking. Robinson criticizes the solutions that only appeal to the sense of sight for urban dwellers that are longing for nature. Following these elements, he also illustrates the distorted situation of presenting nature as a new object of desire for the wealthy urbanite.

Secondly, the study examines modern interiors. The data shows that the visuality-oriented modernist ideals excluded daily life at several points. This problem created good-looking but dysfunctional spaces stacked with multiple functions. Focusing on visuality, covering up the problems, and excluding the traces of daily life both in representation and production created these problems. One of the most intriguing examples is the problem of "having guests" in these visually perfect, designed environments. Robinson satirizes these situations in his drawings (Figure 3).

Lastly, the paper argues on modern furnishings and their effects on daily life. The period of industrially mass produced furniture started with the new techniques of the modern era. The concept of modern aesthetics began to emerge with new techniques and materials such as steel and tubular structures. This situation created countless copies in housing and led to standardization and uniformity. These new mass produced forms and feelings were unfamiliar. The cold nature of these materials and furniture was also a matter of criticism.

Robinson also criticizes the modern furniture designs that aim for "multifunctionality". The satires point out that the dwellers struggle between the visuality as a design parameter and the needs of daily life. Types of furnishing that cannot adapt to the lifestyle of the society emerged in that era. It is seen from the drawings that the idea of multifunctionality did not function as planned.

In the light of these data, the article examined Robinson's drawings and revealed teachings that could be beneficial for the production. The study concludes that the designers should question the current relationship between nature and the built environment. They should accept that every aspect of life is not controllable. Rather than predicting life, experiences can be constructed more flexibly. The most significant element is the acceptance that the interior is a place to live. It should not be designed only on a visual basis. Designing by evaluating



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Table 1. Facts & findings.

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the data of daily life should be accepted as a prerequisite. Taking "actions" as design parameters instead of functions is a step to improve these circumstances. Thus, actions manage spaces in a better flow than assigned functions. Designers should handle daily life with 'real' data while creating furniture and structures. For space constraints, new and adjustable plans can be an alternative. Designers have to balance the visual and daily life routines. Visuality and the function should support and exist without interfering with each other.

Exploring the creation of the home from different disciplines opens several opportunities for further production. It is essential to shed light on the problems that are still up-to-date and learn from these productions. Learning from researches and creations in such a period and discussing it can provide different perspectives for new bearings.

Moreover, these perspectives of caricatures can also be beneficial for architectural education. This relationship could be addressed for further studies. It could open new discussions and create new angles on the modern era for architecture history classes. It could also be integrated into the design studios. The potential of these caricatures and the satire can be beneficial for students to understand the idea of everyday life and user-designer relationship.

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Performance management of contractor's quantity surveyors through the use of proper documents and records

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Abstract

Errors in construction documents and records can have serious impacts on construction projects. These impacts are manifested mostly during the construction and post-construction stages of the projects. The errors in documents and records significantly affect the performance of quantity surveyors (QSs) working for contractors. Thus, the aim of this study was to investigate how the performance of contractor QSs could be managed using proper documents and records. A mixed approach was used to collect the required empirical data via a series of interviews and a questionnaire survey. The collected data were analysed using manual content analysis and relative important index, respectively. The results of the analysis indicate the documents and records that are significantly relevant to contractor QSs. Similarly, significant errors that can occur in those documents and records and causes of those errors also were identified. Finally, the solutions that could minimize the errors were identified and ranked according to their significance. The study findings revealed that the use of proper documentation and record management can enhance the performance of contractor QSs and ensure project success by controlling cost and time overruns.

Keywords

Causes, Contractor QS, Documents and records, Errors, Solutions.

1. Introduction

Documents and records are inseparable in any construction project (Sundhar & Nandhini, 2015). They are the mirrors of the project and reflect the state of the project while boosting quality assurance and quality control aspects of the project (Gangane et al., 2017). Without proper documentation and record keeping, achieving project success would be a challenge (Akinradewo et al., 2020; Canteli, 2019). Errors in construction documents and records significantly contribute to poor project performance (Dosumu, 2018; Dosumu et al., 2017). Okuntade (2014) states that more than 82% of all construction errors are related to errors in construction documents and records.

Dosumu (2018) concludes that in contract documents, the highest number of errors is in contract drawings, followed by bills of quantities (BOQs) and specifications in that order. These errors are caused by the frequent design changes made by the client (Domusu et al., 2017). Thus, clients are mainly responsible for the errors in construction documents and records (Sunday & Afolarin, 2015). The frequent design changes made by the clients send designers back to the drawing board and thus require the quantity surveyors (QSs) to prepare fresh BOQs (Dosumu et al., 2017). Therefore, errors in documents and records significantly affect the performance of QSs. The effects of the errors manifest mostly during the construction and post-construction stages of the projects (Sunday & Afolarin 2015). The effect of documentation and record keeping errors on the performance of contractor QSs is higher than their effect on the performance of consultant QSs. Hence, the investigation of the effects of errors in construction documents and records on the performance of contractor QSs is important.

Literature mentions the errors that can occur in construction documents and records (Long, 2011; Vrouwenvelder et al., 2009; Love et al., 2008; Palaneeswaran et al., 2007). The causes of those errors (Dosumu et al., 2017; Dosumu & Adenuga, 2013; Love et al., 2011) and the effects of the errors (Dosumu, 2018; Okuntade, 2014; Dosumu & Iyagba, 2013; Love et al., 2011) also are emphasised in the literature. The literature also discusses the strategies that can be adopted to manage those errors (Sunday & Afolarin, 2015) by holistically considering the projects. However, the literature that discusses the impact of poor construction document and record management on the performance of contractor QSs is scarce. The level of significance of the documents and records that QSs handle, the errors in those documents and records and the causes of those errors have been under-researched. Since contractor QSs have to work with and be responsible for many construction documents and records, proper document and record management will be essential to QSs (Towey, 2017). This study, therefore, was intended to enhance the performance of contractor QSs by identifying the causes and effects of errors in construction documents and records, and thereby minimise the errors (Sunday & Afolarin, 2015).

Thus, the aim of the study was to explore how the performance of contractor QSs could be managed by using proper documents and records. The objectives of the study were to identify the significant documents and records handled by contractor QSs; significant errors that can occur in those documents and records, and significant causes of those errors; and suggest strategies to minimise the identified errors.

2. Literature review

2.1. Document and record management in construction projects

All records are documents although not all documents are records (Gangane et al., 2017). Thus, documents and records are two different items. Construction documents contain information, while records contain evidence of past work, which can be used as proof of that work (Sunday & Afolarin, 2015). The main purpose of construction documents and records is to circulate information among construction stakeholders and convey messages to the stakeholders in the best possible way to guide them on the work to be done (Dowing, 2016). Construction documents shall include but not be limited to contract drawings; schedules; specifications; BOQs; quality management plans; construction programmes; project health and safety plans; conditions of contract; and all-risk insurance for building works, personnel and equipment (Dosumu, 2018; Dosumu & Iyagba, 2013).

Construction document management is critical in a project because it provides a comprehensive record of the project (Benarroche, 2020). The type of construction management adopted can differ from project to project and from stage to stage of the project (Gangane et al., 2017). Most documents used in a construction project go through numerous rounds of revisions and editing because of change orders made to adjust the scope of work (Benarroche, 2020). Therefore, construction documents of a project provide a permanent record of the events and actions related to the project, enabling their detailed reconstruction, review and analysis (Sutton, 2014). Documentation is the foundation on which all proposals, changes, orders, and claims are built (Benarroche, 2020). Construction documents and records are the means through which information flows among the stakeholders (Sunday & Afolarin, 2015). The way the documents are perceived varies among individuals (Lee and Foo 2020). Thus, document and record management is essential for all construction stakeholders to ensure proper project implementation.

2.2. Document and record management by contractor QSs

The client, consultant, and contractor are the major stakeholders of a construction project (Satankar & Jain, 2015; Meyer & Kara, 2020). The basic responsibility of a contractor is to deliver the works in accordance with construction documents (Sunday & Afolarin, 2015). The construction documents that QSs require to perform their roles successfully include almost all project asset data and records (Towey, 2017). Ashwoth et al. (2013) emphasised that QSs are required to prepare several documents pertaining to the contract of which the BOQ is one of the most important documents that has to be professionally prepared complying with the standards (Bandara, 2018). One key purpose of

construction document management by contractor QSs is to ensure that the delivered works are in line with the agreed BOQ in terms of cost, time and quality (Cunningham, 2015). Tender document preparation is also a key task of QSs and it requires the QSs to refer several other documents, such as BOQs, conditions of contract and preambles to the schedules of prices. (QS-Tuts, 2019). Documentation is one of the skills and competencies required by QSs (Oke & Otasowie, 2020; Oke et al., 2018). Contractor QSs spend less time on cost planning, feasibility studies and tender appraisal than they do on post-contract critical services (Cunningham, 2017).

Most of the financial issues faced in building construction are caused by inadequate or unclear tender documents and culminate in disputes between employers and builders on the items included in the price of the work (Cunningham, 2015). Therefore, QSs need to have a clear understanding of the nature and purpose of the various documents they use. In contracting organisations, poor cost performance reduces or eliminates profit margins, which may lead to project or company failure (Hongtao, 2014). Cost overruns are a major problem in construction companies. Therefore, record management becomes necessary for a contractor QS because it would help minimise material waste and financial losses and provide useful evidence during any litigation (Gangane et al., 2017). Cartlidge (2017) comments 'planning is only half of the story and once a project commences on site there is a need to control cost targets to ensure that costs do not spiral out of control'. Therefore, contractor QSs should strive to improve their cost controlling and accounting capabilities to help the construction companies for which they work (Cunningham, 2017).

2.3. Errors in documents and the causes and impacts of the errors

Busby (2001) defines errors as unexpected occurrences that involve surprise and which cannot be entirely attributed to chance or circumstances. Many factors have been traced to poor project performance and errors in construction documents and records are prominent among them (Dosumu

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et al., 2017). Emphasising the gravity of these errors, Okuntade (2014) affirmed that errors in construction documents and records amount to more than 82% of all construction errors committed and that they contribute to a 5% increase in the contract value of the project (Love et al., 2011). Thus, the identification of the causes of the errors is important to minimise the errors (Dosumu & Iyagba, 2013).

Causes of errors in construction documents and records vary based on the types of buildings involved and the services rendered by the construction organisations and states concerned (Dosumu et al., 2017). Thus, errors in documents and records are of different types and can be classified in diverse ways (Sunday & Afolarin, 2015). Dosumu et al. (2017) found that frequent design changes made by clients were the most frequent cause of errors. The clients and consultants were more responsible for those errors than the contractors were (Dosumu & Iyagba, 2013).

The effects of errors in documentation were the abandonment of work, delays, rework, dissatisfaction of the owner, loss of confidence in the consultants, loss of consultants' reputation, frustration of the stakeholders, loss of concentration on other projects, discouragement of the investors and lowering of the profits made by the designers (Shrivas & Singla, 2020; Gangane et al., 2017). Fatawu (2016) mentions that project abandonment, delays (time overruns), cost overruns, payment claims, and variation/ change orders are the major impacts of errors in documents and records. Rework, cost overruns, and time overruns are the common impacts of the errors in documents and records as identified in almost all the literature related to errors in construction documents and records (Larsen et al., 2015).

Love et al. (2011) suggested that a multitude of strategies should be collectively adopted to prevent errors in documents and records and ensure satisfactory project performance. Initially, clients should provide adequate time for the preparation of construction documents and records and adopt appropriate procurement methods to minimise the errors (Oluwaseum et al., 2013). Designers are advised to apply quality assurance once the designs have been prepared (Dosumu et al., 2017; Sunday & Afolarin, 2015; Dosumu & Iyagba, 2013). Oluwaseum et al. (2013) identified providing comprehensive information, refining the communication skills of the stakeholders and improving project management as the most suitable strategies. However, none of the previous studies have focused on the relationship between QSs and document and record management.

2.4. Need for document and record management by contractor QSs

Because of the adverse effects of errors in the construction documents, identifying the factors responsible for those errors is important for the professionals who prepare construction documents (Dosumu & Iyagba, 2013). These effects are manifested mostly during the construction and post construction stages of the projects (Sunday & Afolarin, 2015). Therefore, document and record management will be critically important during post construction stages although errors caused by the client and the consultants frequently occur during the design stage (Dosumu et al., 2017). Gunawardena and Kumana (2007) also emphasised the need for proper documentation and record keeping by the contractors. Dhakal et al. (2020) suggest ontology-based semantic modelling for document classification, which helps document management.

Contractor QSs, being the key stakeholders of construction projects, play a major role in ensuring project success during the construction and post contract stages of a project (Jasper, 2015; Latiffi et al., 2015). They should strive to improve the cost controlling of project for the benefit of the construction companies for which they work (Cunningham, 2017). However, most of the financial problems originate because of inadequate or unclear tender documents, culminating in disputes between employers and builders over the items included in the price of the work (Cunningham, 2015). Therefore, QSs should have a clear understanding of the nature and purpose of the various

Table 1. Profiles of the interviewees and questionnaire survey respondents.

Details of the Interviewees									
Code Designation			Profession	Total Experience in Years		No. of Years of Experience as a Contractor			
R1	Senior Architect		Architecture	16		12			
R2	Senior Engineer		Engineering	20		16			
R3	Contract Specialist		Quantity Surveying	30		22			
R4	Architectural Consultant		Architecture	20		14			
R5	Project Manager		Engineering	25		24			
R6	Project engineer		Engineering		16	11			
R7	Claims manager		Quantity Surveying		15	12			
R8	Director		Quantity Surveying		25	20			
R9	Chief QS		Quantity Surveying		28	24			
R10	Deputy General Manager		Quantity Surveying		26	19			
R11	Assistant General Manager		Quantity Surveying	17		14			
R12	Assistant General Manager		Quantity Surveying	16		12			
R13 Contracts Manager			Quantity Surveying	20		16			
R14 Chief QS			Quantity Surveying	23		17			
R15 Managing Director			Quantity Surveying		21	13			
R16 Project QS			Quantity Surveying		23	14			
R17	Senior QS		Quantity Surveying		28	25			
R18 Contracts Manager		Quantity Surveying		28		26			
R19 Commercial Manager		Quantity Surveying		22		22			
	Details	of the	Questionnaire Surv	ey Respo	ndents				
	Work Experience								
	(Years)	6-11	11-15	16-20	21-25	Above 25	Total		
	Designation								
Quantity Surveyor		08	10	-	-	-	18		
Senior Quantity Surveyor		04 08		03	-	-	15		
Chief Quantity Surveyor			-	08	08	-	16		
Cost Controller			04	06	02	-	12		
Commercial Manager			04	04	06	03	17		
Assistant General Manager		-	02	04	06	04	16		
Managing Director		-	-	03	04	05	12		
	Total	12	28	28	26	12	106		

documents they use. The BOQ is one of the most important documents prepared by consultant QSs and it has to be properly maintained by contractor QSs (Ashwoth et al., 2013) to ensure that the delivered works are in line with the agreed BOQ in terms of cost, time and quality (Cunningham 2015) and ensure compliance with building codes (Amarachukwu & Wilkinson, 2020). Fatawu (2016) and Noruwa et al. (2020) mention that variations are the major impacts of errors in documents and records. According to Dosumu et al. (2017), 92% of the variations in the Australian construction industry are attributable to errors in construction documents. Perera et al. (2019) have identified that late, incomplete, and substandard information is one of the root causes of variations. The contractor QS is one of the key professionals expected to perform competently when variations are inevitable (Maarouf & Habib, 2011) because variations can adversely affect contracting firms (Yadeta, 2016; Hanna et al.. 2002). Therefore, the proper management of documents and records is necessary for a contractor QS because it would help minimise waste, financial losses, quality controlling issues, disputes and at times the insolvency of the contractor (Gangane et al., 2017). Thus, according to the past studies mentioned, a study on construction document management and record keeping will be useful for contractor QSs to enhance the overall performance of the contractor.

3. Methodology

A mixed approach was found to be most suitable for this study since because it helps integrate both qualitative and quantitative data (Uprichard & Dawney, 2019) and discover the research problem in depth (McCusker & Gunaydin, 2015). In the first part of the study, a qualitative approach was used to assess the validity of the literature findings on the documents and records used in the construction industry and the errors in those documents and records, causes of the errors and the strategies that would prevent those errors. A quantitative approach was suitable for the second part of the study to identify the significance of the findings of the first part of the study. Expert interviews were most suitable to collect the required qualitative data based on the experience of the experts (Fellows & Liu, 2015). Experts who had more than 15 years of experience in construction and more than 10 years of experience as a contractor QS were selected for interviewing. Semi-structured interviews were conducted face to face for 45-60 minutes. The interview guideline was prepared based on the literature review findings. Expert interviewees and questionnaire survey respondents were selected using purposive sampling to enable the selection of those with experience and knowledge in the research area. The number of interviews was limited to 19 to avoid data saturation. The empirical findings of the interviews were analysed using manual content analysis. The profiles of the interviewees and the questionnaire survey respondents are presented in Table 1.

The questionnaire survey respondents had to have more than 5 years of working experience as contractor QSs. The questionnaires were distributed via email among 150 respondents, who were selected from a population of 400. Only 111 survey respondents returned the filled-up questionnaires. Five of the received questionnaires were incomplete. Therefore, only 106 (70.7%) questionnaires could be considered for the analysis.

The questionnaire survey findings were analysed using the relative importance index (RII), a well-recog-

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nized statistical tool used to measure the relative significance of several attributes (Doloi, 2008) and rank them (Tejale et al., 2015). RII = Σ (Wn) / N x A is the formula used to calculate RII, where W = rating given to a factor by each of the respondents; n = frequency of the responses; N = total number of responses and A = the highest weight.

Three identical colour scales were used to represent the data in a heat map to visualise the findings. In the heat map, high values are presented in "green", moderate values in "yellow", and low values in "red" (Figure 1). Thus, the factors with a high impact/ranking/ significance are presented in "green", whereas those with a low impact/ranking/significance are presented in "red".

4. Research findings and analysis

The interviewees were requested to assess and validate the literature findings particularly applicable to contractor QSs. They were free to add to the literature findings. The additions they made are highlighted in the relevant tables. The significance of the interview findings was finally identified using the relative importance indices (RIIs) calculated based on the questionnaire survey findings.

4.1. Documents and records significant to contractor quantity surveyors

Documents and records identified from the literature review were classified into four main categories: documents used by contractor QSs, documents for which contractor QSs are responsible, records used by contractor QSs and records for which contractor QSs are responsible. Eight construction documents used by contractor QSs and twelve documents for which contractor QSs are responsible were identified. Eleven records were identified as records used by contractor QSs, while nineteen were identified as records for which contractor QSs are responsible. The questionnaire survey respondents were requested to identify the significance of each of the identified documents/records for contractor QSs and rank them according to their levels of significance. The results are presented in Table 2.



Figure 1. Heatmap colour scale.

Documents and records that were identified by the experts are highlighted in Table 2. Organisational chart, marked drawings/ sketches, gazette notifications, site clearance requests, change requests, variation valuation confirmation and approval request forms were the new documents/records identified by the experts.

In Table 2, the colour scale varying from dark green to dark red shows the documents and records relevant to contractor QSs in the descending order of their significance. Contract documents and specifications with RIIs of 0.906 and 0.903, respectively, and in shades of green are the most significant documents used by contractor QSs. Staff organisation charts with a RII of 0.456 and shown in red are the least significant documents used by contractor QSs. The first six documents listed under the documents for which contractor QSs are responsible are the most significant documents according to the colour scale. The two most significant documents among them are the variation applications and interim payment applications, coloured in dark green. Subcontract agreement-related documents and monthly progress reports are the two least significant documents for which contractor QSs are responsible.

Daily site progress, labour, material, and daily work records with a RII of 0.867 are the records most significant to contractor QSs. These same records (with a RII of 0.761) are the 9th most significant records for which contractor QSs are responsible. Claim notices and correspondence, quotations and invoices, and price and rate breakdowns are the three most significant records for which contractor QSs are responsible. Confirmation of verbal instructions (CVIs)/ Engineer's instructions (with a RII of 0.511) and shaded in red is the 2nd most significant record used by contractor QSs. Health, safety, and environmental

records/accident records carry low significance for contractor QSs. They are also of low significance as records for which contractor QSs are responsible. *Quality assurance records* are the least significant records for which contractor QSs are responsible. However, with a RII of 0.761, they are the 3rd most significant records used by contractor QSs.

4.2. Significance of the errors in documents and records handled by contractor QSs

From the literature, 11 errors in documents and records that are of significance for QSs were identified (Table 3). *Documents/records that are inconsistent with the source document* and *quotations*

Table 2. Significance of documents and records handled by contractor QSs.

		De	ocuments			
Documents used by Contractor QSs	RII	Rank	Documents for which contractor QSs are responsible	RII	Rank	
Contract documents	0.906	1	Variation applications	0.984	1	
Specifications	0.903	2	Interim payment applications	0.968	2	
Cash flow	0.761	3	Subcontract payment documentation	0.935	3	
Construction programme	0.720	4	Claim documents	0.924	4	
Shop, as-built and revised drawings	0.717	5	Final statement	0.913	5	
Weather reports	0.594	6	Periodic cost reviews/cost reports	0.895	6	
Test reports	0.594	7	Dispute-related documents	0.889	7	
Organisational charts (Staff)	0.456	8	Completion statement	0.886	8	
v		••••••	Material reconciliation reports	0.795	9	
			Labour reconciliation and productivity reports	0.703	10	
			Subcontract agreement-related	0.556	11	
			Monthly progress reports	0.528	12	
			Records			
Records used by Contractor QSs	RII	Rank	Records for which Contractor QSs are responsible	RII	Rank	
Daily site progress, labour,	0.867	1	Claim notices/ correspondence/ letters	0.900	1	
Confirmation of verbal instructions/	0.861	2	Quotations/ Invoices	0.865	2	
Quality assurance records	0.761	3	Price breakdowns/ Pate breakdowns	0.853	3	
Store recorde	0.728	1	Change requests	0.832		
Marked drawings/ sketches	0.728	5	Variation valuation confirmation	0.832		
Cartificates/ Dormits	0.607	6	Marked drawings/ Sketches	0.817	6	
Clarifications/ Requests for	0.694	7	Site clearance requests	0.809	7	
Mathad statements	0.623	8	Clarificatione/ Dequests for information	0 772	8	
Photographs	0.622	9	Daily site progress, labour, material and	0.761	9	
Health and safety environment	0.578	10	Certificates/ Permits	0.561	10	
Gazette notifications	0.567	11	Approval request forms	0.557	11	
	0.001		Weather records	0.550	12	
			Gazette notifications	0.537	13	
			Method statements	0.533	14	
			Photographs	0.528	15	
			Confirmation of verbal instructions/	0.511	17	
			Health and safety environment records/	0.461	18	

that are inconsistent with the specifications, which are highlighted in Table 3, were the errors identified by the experts. The RIIs of the identified errors and their rankings according to their levels of significance are presented in the Tables 3 and 4, respectively.

In the heat map, 4 of the 10 errors are in shades of green, and thus are significant. Among these four significant errors, lack of substantiation, the failure to provide the required evidence or supporting records and document backup, with a RII of 0.767 is the most significant. Documents/records that are inconsistent with the required specimen or format, failure to use relevant documents/ records or false records and details, and calculation mistakes in the measurement sheets are the 2nd, 3rd, and 4th most significant errors. Warranty errors, which have received the lowest RII of 0.467 and shaded in dark red, are less significant. Five out of the eleven errors are coloured with a shade of red.

4.3. Significance of the causes of the identified errors in documents and records

At the expert interviews, 11 causes were validated as being responsible for the errors in documents and records of contractor QSs. These 11 causes were ranked according to their significance using their RIIs, and the interviewees were requested to group the causes according to the errors for which they were responsible (Table 3). The highlighted causes in Table 3, namely *lack of interest* and *frequent* changes *made to the details*, are the causes identified by the interviewees.

	Table 3. Signific	ance of the errors in d	ocuments	and reco	rds and the causes of th	ie errors.
ì	Error	Cause	RII	Error	Cause	RII
í	Failure	to keep contemporary records	0.869	Quotations that	Time constraints faced in handling the workload	0.840
	Time c	onstraints faced in handling the workload	0.840	are inconsistent	Lack of interest	0.794
	A CONTRACTOR OF A CONTRACTOR OF					

	Failure to keep contemporary records	0.869	Quotati	ons that	Time constraints faced in handling the workload	0.840
and the second second	Time constraints faced in handling the workload	0.840	are inconsistent		Lack of interest	0.794
Lack of substantiation	Lack of interest	0.794	with	the	Lack of trained and knowledgeable employees	0.789
	Unfamiliarity with the conditions of contract	0.782	specifi	cations	Dependency on subcontractors lacking in knowledge	0.743
	Internal organisation-related problems	0.749	Rank	RII	Inadequate communication with the members	0.737
Rank RII	Dependency on subcontractors lacking in knowledge	0.743	7	0.611	False records	0.688
1 0.767	Inadequate communication with the members	0.737			Time constraints faced in handling the workload	0.840
Documents/records that	Time constraints faced in handling the workload	0.840	1		Lack of interest	0.794
are inconsistent with the						
required specimen or	Lack of interest	0.794	Briging of	marc/ rate	Lack of trained and knowledgeable employees	0.789
format		and the second	Flicing er	nors/ rate		
Rank RII	Lack of trained and knowledgeable employees	0.789	Duild-u	p enois	Unfamiliarity with the conditions of contract	0.782
2 0.744	Lack of quality assurance	0.731			Dependency on subcontractors lacking in knowledge	0.743
100000 00 00 00	Failure to keep contemporary records	0.869			Inadequate communication with the members	0.737
Failure to use relevant	Insufficient time available to handle the work load	0.840			False records	0.688
documents or records/	Lack of interest	0.794	Rank	RII	Drawing errors	0.651
False records and	Lack of trained and knowledgeable employees	0.789	8	0.600	Unrealistic programmes	0.571
details	Dependency on subcontractors who are not knowledgeable	0.743	10000		Time constraints faced in handling the workload	0.840
	Poor communication with the members	0.737	Wr	ong	Lack of interest	0.794
Rank RII	Lack of quality assurance	0.731	interpre	etations	Lack of trained and knowledgeable employees	0.789
3 0.726	False records	0.688			Unfamiliarity with the conditions of contract	0.782
Calculation mistakes	Insufficient time available to handle the work load	0.840	Rank	RII	Inadequate communication with the members	0.737
present in measurement	Frequent changes made to the details	0.794	9	0.583	Language barriers	0.671
sheets	Lack of trained and knowledgeable employees	0.789			Insufficient time available to handle the work load	0.840
Rank RII	Drawing errors	0.651	irrele	evant	Lack of interest	0.794
4 0.722	Lack of interest	0.583	catego	risation	Lack of trained and knowledgeable employees	0.789
Missing potifications/	Failure to keep contemporary records	0.869	10000000000		Unfamiliarity with the conditions of contract	0.782
contractual pointe	Time constraints faced in handling the workload	0.840	Rank	RII	False records	0.688
contractual points	Lack of interest	0.794	10	0.539	Language barriers	0.671
Rank RII	Lack of trained and knowledgeable employees	0.789			Lack of interest	0.794
5 0.667	Unfamiliarity with the conditions of contract	0.782			Unfamiliarity with the conditions of contract	0.782
Documents/records that	Lack of interest	0.794	Warrant	y Errors	Internal organisation-related problems	0.749
are inconsistent with the	ack of trained and knowledgeable employees	0 789			Insdequate communication with the members	0 737
source document	cautor and and ano monorgoable employees	0.105	1 1 1 1 1 1			0.101
Rank RII	Unfamiliarity with the conditions of contract	0.782	Rank	RII	False records	0.688
b 0.650	Language barriers	0.671	11	0.467	Language barriers	0.671

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E	Error	Strategy	RII	Er	ror	Strategy	RII
		Using property designed checklists for documents and records	0.918	Quotations that are		Getting a qualified and responsible person to prepare/check the	
		Keeping contemporary records	0.886	inconsis the spec	stent with cifications	Establishing proper communication and teamwork among the members	
Lack of substantiation		Getting a qualified and responsible person to prepare/check the documents/records	0.829	Rank	RII	Distributing the work and responsibilities among the team members	0.794
		Making arrangements for obtaining contemporary records	0.811	7	0.611	Checking and verifying the backup records before their use	0.771
		Checking and verifying the backup records before their use	0.800	2		Keeping contemporary records	0.886
Rank	RII	team members	0.794			documents/records	0.829
1	0.767	Distributing the work and responsibilities among the team members	0.771	Pricing e	rrors/ rate	Visiting the site at least once a day	0.818
Docume	anteiracorde	Using standard or given formats for the records	0.931	build-u	p errors	Checking and verifying the backup records before their use	0.811
that are	inconsistent	Getting a qualified and responsible person to prepare/check the documents/records Using applicable quality management procedures				Making arrangements for obtaining contemporary records	0.800
specime	e required en or format					Establishing proper communication and teamwork among the team members	0.794
Rank	RII	Distributing the work and responsibilities among the team members	0.794	Rank	RII	Distributing the work and responsibilities among the team members	0.771
2	0.744	Using draft documents and developing them based on feedback before submitting them	0.729	8	0.600	Using draft documents and developing them based on feedback before submitting them	0.729
		Keeping contemporary records	0.886			Getting a qualified and responsible person to prepare/check the documents/records	0.829
		Maintaining a directory of records as a record management practice	0.840	Wrong interpretations		Establishing proper communication and teamwork among the team members	0.800
		Getting a qualified and responsible person to prepare/check the documents/records		0.829		Making proper claims based on relevant contractual grounds	0.800
Failure to document	use relevant ts or records/	Visiting the site at least once a day	0.818	Rank	RI	Distributing the work and responsibilities among the team members	0.794
False n d	ecords and etails	Making arrangements for obtaining contemporary records	0.811	9	0.583	Using draft documents and developing them based on feedback	0.729
		Establishing proper communication and teamwork among the	0.800	2	1100000000	Getting a qualified and responsible person to prepare/check the	0.829
		team members Checking and verifying the backup records before their use Using applicable quality management procedures		.800 Irrelevant categorisation		documents/records Making proper claims based on relevant contractual grounds Distributing the work and responsibilities among the team	0.800
							0.794
Rank	RII	Distributing the work and responsibilities among the team	0.771	Rank	RII	Checking and verifying the backup records before their use	0.771
3	0.726	members Using draft documents and developing them based on	0.729	10	0.539	Using draft documents and developing them based on feedback	0.729
Calculati	ion mistakes	reedback before submitting them	Concession of the local division of the loca	-		before submitting them	
pre	sent in ment sheets	Getting a quarted and responsible person to prepare/check the documents/records	0.829	Warran	ty Errors	record	0,918
Rank	RII	Distributing the work and responsibilities among the team members	0.794	Rank	RI	Getting a qualified and responsible person to prepare/check the documents/records	0.829
4	0.722	Using draft documents and developing them based on feedback before submitting them	0.729	11	0.467	Distributing the work and responsibilities among the members	0.794
Missing	notifications/	Getting a qualified and responsible person to prepare/check	0.829				
Rank	RII	Making proper claims based on relevant contractual grounds	0.800				
5	0.667	Distributing the work and responsibilities among the team members	0.794				
Documents/records		Getting a qualified and responsible person to prepare/check	0.829	1			
with th	he source	Making proper claims based on relevant contractual grounds	0.800				
dot Rank	Ril	Distributing the work and responsibilities among the team	0.794				
6	0.650	members Using draft documents and developing them based on	0.729				
0.0	2001000	reedback before submitting them	and the second second				

Table 4. Significance of strategies suitable for the identified errors in documents and records.

Failure to keep contemporary records and time constraints faced in handling the workload with RIIs of 0.869 and 0.840, respectively, are the two most significant causes of errors in the documents and records handled by contractor QSs. The five causes coloured in shades of green in the heat map are the five most significant causes. Two of the five causes are coloured in dark green. Though lack of interest is the 3rd most significant cause, it is responsible for 10 of the identified errors. The most significant cause and the second most significant cause are responsible for 2 and 9 of the errors, respectively. The use of unrealistic programmes is responsible for pricing errors/ rate *build-up errors* although these errors are least significant with a RII of only 0.571. However, the minimisation of pricing errors/ rate build-up errors is important even though it is insignificant. As Table 3 indicates, among the 13 identified causes, 9 are responsible for pricing errors and rate build *up errors*, which are only the 8th most significant type of errors with a RII of 0.600 and coloured in a shade of red. Similarly, only 4 out of the 13 causes are responsible for the 2nd most significant error that occurs when the documents/records are inconsistent with the required specimen or format.

Therefore, the levels of significance of the errors and their causes need to be considered in minimising the errors.

4.4. Significance of the strategies that would minimise the errors in documents and records

From the literature, 13 strategies that would minimise the errors in documents and records for which contractor QSs are responsible, were identified. The interviewees were requested to indicate the errors that each identified strategy would minimise. Questionnaire survey findings were used to rank the strategies according to their significance based on their RIIs. The results are presented in Table 4. The table also presents the strategies for minimising each error. The strategies checking and verifying the backup records before their use and maintaining a directory of records as a record management practice, which are highlighted in the table, were identified by the experts.

Using standard s or given formats for the records (RII=0.931), using properly designed checklists for documents and records (RII=0.918) and keeping contemporary records (RII=0.886) are the three most significant strategies that would minimise the errors. Using draft documents and developing them based on feedback before submitting them is the least significant strategy. However, the number of errors that can be minimised through this least significant strategy is higher than the number of errors that can be minimised using the three most significant strategies. Getting a qualified and responsible person to prepare/check the documents/records is the 5th most significant strategy, which can eliminate all the errors in documents and records. As Table 4 indicates, only 7 of the 13 strategies are suitable to minimise *lack* of substantiation (having the highest RII), the most significant error in documents and records. Most of the identified strategies (10 out of 13) are focused on minimising the error associated with the failure to use relevant documents or records/ false records and details, which is the 3rd most significant error, for which 8 out of the 13 identified causes

5. Discussion

are responsible.

Although several researchers discussed construction documents and records, only Gangane et al. (2017) explained the difference between construction documents and records. The findings of this study revealed that the documents and records handled by contractor QSs could be discussed under four main categories. The interviewees highlighted that documents and records used by different stakeholders vary. Dosumu et al. (2017) also emphasised this variation. Therefore, the stakeholders have to use the documents or records prepared by them and those that have been prepared by others. Thus, documents and records can be categorised as documents and records prepared by contractor QSs and documents and records used by contractor OSs.

Previous studies identified clients and consultants as the major contributors to most of the errors in documents and records (Sunday & Afolrin, 2015). However, the impacts of these errors occur only during and after the construction period (Dosumu et al., 2017; Benarroche, 2020). Therefore, document and record management of contracting firms is important as revealed in this study. Although several construction documents and records could be identified from the literature

(Towey, 2012; Dosumu & Iyagba, 2013; Gangane et al., 2017), only few of those documents were related to contractor QSs. Dosumu (2018) identified that the percentage of errors in BOQs was the 2nd most significant error, followed by errors in drawings. Gangane et al. (2017) identified the errors in BOQs, drawings, specifications, forms of contract and schedules as the most significant errors (listed in the descending order of significance) in documents. The documents and records that were identified as most significant for contractor QSs in the study were identified by Towey (2012) as well.

Sunday and Afolrin (2015) identified inexperience of the professionals, non-availability of information, and lack of quality management as the three most significant causes of errors in construction documents and records. These causes were identified in this study as the 4th, 8th, and 9th most significant causes of errors in the documents and records handled by contractor QSs. This difference between the level of significance of each of the three causes identified by past studies and that identified by this study is because this study focused only on the documents and records handled by contractor QSs. Sunday and Afolrin (2015) focused on all types of construction documents and records. The most significant cause identified in this study is the failure to keep contemporary records. Although all professionals in the construction industry are expected to keep contemporary records, it is essential for contractor QSs because they have to handle claims.

The study findings indicate that *lack* of substantiation is the most significant error, whereas design errors have been identified as the most significant error in the literature (Love et al., 2011). The most significant cause and the most significant error identified in this study are interrelated because the failure to keep contemporary documents is the main cause of the error lack of substantiation. Dosumu and Adenuga (2013) categorised errors according to the types of construction documents and identified design errors in the drawings as the most significant error; approximation errors in the BOQs are the

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third most significant error, followed by design errors in the specification.

Failure to keep contemporary records was identified in this study as the most significant cause of the errors in the documents and record handled by QSs. Even though the literature on the errors in the documents and records handled by contractor QSs is scarce, poor communication among the project members and the negligence of the professionals were highlighted in the literature as the two most significant causes of errors in the BOQs, one of the important documents used by contractor QSs (Fatawu, 2016). These two causes, however, were identified in this study as the 7th and 8th most significant causes, respectively. According to Fatawu (2016), insufficient input information is the most significant cause of errors in construction documents.

The study findings indicate that *the use of standard formats for documents and records* is the most appropriate strategy to minimise errors in documents and records. Dosumu (2018), however, identified the provision of comprehensive information for document and record management as the most significant strategy, which, according to this study, is the most suitable strategy to address the most significant error identified in the study.

6. Conclusions and recommendations

How the performance management of contractor QSs using proper documents and records could be achieved was explored by identifying the significant documents and records handled by contractor QSs, significant errors that could occur in those documents/ records and their causes, and the strategies that would minimise the identified errors, through a mixed approach. The study findings indicate that documents and records can be classified into four main categories: documents used by contractor QSs, documents for which contractor QSs are responsible, records used by contractor QSs, and records for which contractor QSs are responsible. Contract documents and specifications were identified as the most significant documents used by contractor QSs and other construction professionals. Even though cash flow statements and other

similar documents used by QSs also were identified as important, they are not as significant as contract documents and specifications. *Daily site progress, labour, material, and day work records* and *CVIs and Engineer's instructions* were identified as the most significant records used by contractor QSs, which are used by both contractor QSs and other construction professionals.

Variation applications were identified as the most significant documents for which contractor QSs are responsible. Variations are one of the major factors contributing to cost overruns of a project. *The interim payment application* was identified as the next most significant document because the request for the payments for the work done is made by a contractor through this document. *Claim notices, correspondence, and any other substantiation*, being mandatory records for making claims by the contractor, are the most significant records maintained by contractor QSs.

Lack of substantiation was identified as the most significant error in documents and records. Time constraints faced in handling the workload, lack of interest and lack of trained and knowledgeable employees are the causes attributable to most of the identified errors. However, failure to keep contemporary records, which had the highest RII, is the most significant cause because with no records available contractor will not be able to make claims. Similarly, using standard or given formats, which had the highest RII, was identified as the most significant strategy, getting a qualified and responsible person familiar with conditions of contract to prepare/check the documents/records, and distributing the work and responsibilities among the team members were found to minimise all identified errors.

The study findings would help reduce waste of money in projects, caused by erroneous documents. The study makes a theoretical contribution by providing proper guidelines for enhancing the performance of contractor QSs through proper document and record management. The study will also contribute to new knowledge related to document management, especially by contractor QSs, which would be useful for future researchers in the subject area. Howev-

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Furniture design proposals for Syrian refugees

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Abstract

Due to civil war and conflict in Syria, Turkey has welcomed more than 3.6 million Syrian refugees since March 2011. Most Syrians living in Turkey are tenants, and they move frequently for numerous reasons. Thus, Syrians' attempts at remaking home are largely centered on furnishing. This study explores the crucial role of furniture in the process of remaking home and focuses on designing furniture for Syrian families' immediate eating, sitting, sleeping, and storage needs via a workshop with design students from different design disciplines and universities in Turkey. This study aims to design furniture for Syrians living in Turkey according to their needs and cultural and behavioral habits. The study method was based on the cultural probe technique blended with ethnographic methods and a human-centered design approach to understand the users' needs for designing. The findings showed that the students considered the cultural codes, beliefs, lifestyle, spatial needs, and tenant status of Syrian families to provide place attachment, sense of belonging, and familiarity and to develop adaptable, affordable, commemorative, customizable, mass-produced, and multifunctional, furniture and contemporary furniture and accessory design proposals. This study will contribute to developing user-friendly furniture and will promote further research based on users' involvement in designing furniture for immigrant and refugee populations, such as Syrians.

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Keywords

Design, Furniture, Housing, Interiors, Syrian refugees.

1. Introduction

After World War II, the biggest mass migration of the 21st century (Yenilmez, 2017) occurred due to the civil war and conflict in the Syrian Arab Republic. Many people have been affected by this crisis, which began in March 2011. Approximately 5.6 million people have been displaced and have migrated to neighboring countries, such as Lebanon, Turkey, and Jordan, and beyond (United Nations Refugee Agency [UNHCR], 2021). Turkey implemented an "open door policy" (Directorate General of Migration Management [DIGM], 2021) for Syrian refugees¹ in the first phase of this mass migration. According to current statistical data, Turkey, in which the largest Syrian immigrant population lives worldwide, hosts 3.6 million Syrian refugees (UNHCR, 2021).

The number of Syrian refugees living in Turkey drastically increased in 2014 due to the ongoing situation in Syria. During this period, 93% of Syrian refugees have dispersed throughout different urban areas and cities (Erdoğan, 2018) due to factors such as the living conditions in reception camps and refugee centers, education, health, and employment. In this process, one of the central problems for Syrians is sheltering. Most Syrians living in Turkey live slums or previous slum areas of big cities, such as Istanbul (Kılıçaslan, 2016) due mostly to their income status. Kinship relations, and cultural, religious, environmental, and psychological factors also affect the settlement choices of immigrant and refugee populations.

Most Syrians have suffered trauma due to the war in Syria: losing their homes, homeland, relationships, relatives, and sociocultural ties. In Turkey, the vast majority of Syrians consist of people with low- or middle-income status and require assistance. Syrians move frequently due to rent increases, their income status, unemployment, negative attitudes of neighbors and landlords, and crowded and large households. Renting versus being a homeowner and their legal status and rights affect immigrants' and refugees' emotional bonds and attachment to a particular place, sense of community, belonging, and familiarity. The living conditions during relocation also affect their residential satisfaction and well-being.

During the process of migration and the remaking of home, it is crucial to have a living environment that responds to the users' living habits, culture, lifestyle, needs, preferences, and desires for providing a sense of community, belonging, familiarity, and place attachment during relocation. Therefore, homemaking practices for immigrant and refugee populations cannot be considered detached from previous experiences, which shape the feelings of the present home (Brun & Fabos, 2015). In other words, the present home includes qualities of former home environments that were lost and left behind.

The fact that Syrians are mostly tenants in their new location makes it difficult to appropriate their present residential environment in remaking home. In this process, furniture and other goods and objects loaded with meaning (Brooker, 2004) have major roles in personalizing the space and reflecting people's identities and tastes. They also enable understanding of users and their needs. In this sense, developing design ideas and products from housing to a piece of furniture for immigrants and refugees is an important activity. Smart design ideas, such as the IKEA Foundation's Better Shelter project (Better Shelter, n.d.) and Rehome's furniture for refugees (Finnish Furniture for Refugees, n.d.), can help solve immediate housing needs of forcibly displaced populations.

This study explores the crucial role of furniture in the process of remaking home and focuses on designing furniture for Syrian refugees via a workshop that aimed to design furniture for Syrians based on their cultural and behavioral habits and needs. The study method used was the cultural probe technique blended with ethnographic methods. The human-centered design approach was also used to produce design proposals both for meeting users' needs and for developing furniture and complementary furniture and accessories in the workshop. The study will contribute to the design discipline by developing creative design ideas and need- and culture-based furniture proposals for Syrian families.
2. Theoretical background

Interior architecture and design is a discipline that focuses on human needs, actions, and inspirations (Attiwill, 2011) to design livable environments. The housing environment we live in constitutes a large part of the built environment and reflects the user's lifestyle, wishes, desires, needs, and cultures. In this sense, the housing environment has always been of crucial importance in the architecture and interior architecture and design fields (Brooker & Stone, 2010).

While the house is a physical unit (Lawrence, 1987), the home-which also has symbolic associations (Boccagni & Brighenti, 2017)-has physical, psychological, social, and cultural aspects. Home is "a place where every day is multiplied by all the days before it" (Tuan, 2011, 144) and a place where people come together under the same roof. Home is also a place for daily and social life that is substituted for both individual and collective and private and public zones. One of the most important emotional bonds, longed for and full of memories of the past, is the home. Therefore, the loss of the home is psychologically, economically, socially, and politically traumatic, especially if this loss is beyond one's control.

The meaning of home for forcibly migrated populations is related to home in their homeland and the memories and trauma they evoke. In this sense, home has negative and positive associations for those people. Previous experiences also affect immigrants' settling down during relocation. Home, where memories are transferred from past to present, is a place of existence (Pala, 2005) and is the physical expression of identity (Fadlalla, 2011) for immigrant and refugee populations. Thus, homemaking during relocation is quite crucial for displaced and forced migrated people and populations.

Homemaking is an ongoing process (Arefi, 2014; Taylor, 2015). Remaking home for immigrants and refugees in a new living environment means establishing a new life influenced by previous experiences and their former homes and homeland left behind (Jansen & Löfving, 2009; Kissoon, 2015). In this regard, the homemaking process is an attempt to remake domestic life blended with familiar cultural values (Kissoon, 2015) that allows people to feel at home, specifically amid a lack of familiarity (Kreuzer et al., 2017). It is also a process of simultaneously being "here" and "there" (Ralph & Staeheli, 2011).

The relationship between space and human who use the space is important in the homemaking process. The human or user needs define a general frame of a design (Dodsworth, 2009). Therefore, the housing environment and interior spaces have the adjustment capacity and flexibility appropriate to the user's needs. The flexible use of residential interiors requires spatial elements, furniture, and other belongings that allow flexible use (Cordan & Aktan Özcan, 2020). In other words, the movable walls and wall units that divide, separate, or combine indoor spaces; compact and movable furniture; fixtures; and other items increase the effective and efficient use of interiors. They also help meet users' changing needs and requirements.

One of the most important considerations for the interior architecture and design discipline is the selection and placement of furniture (Edwards, 2011). As Brooker and Stone (2004) stated, "furniture is an element that expresses human scale and use. It can be worn and used and barely noticeable or have beautiful sculptured qualities" (170). Besides form, material, color, and texture, furniture-whether fixed, semi-fixed, or mobile-has ergonomic, aesthetic, and functional aspects. It also has social and emotional purposes (Edwards, 2011). Furniture as a semi-fixed element (Rapoport, 2005) meets the physical, aesthetic, and belonging needs of the users in home decoration. It also gives information about a user's culture, beliefs, behaviors, lifestyle, taste, habits, and preferences and plays a major role in personalization and other ways of identification (Altman et al., 1980).

The use of objects (i.e., furniture, goods, and decorative items) are the most important elements for providing identity to a particular place, and they have physical and cultural connections with their environment (Brooker & Stone, 2004). Furniture and decorations carry special meanings (Ureta, 2007) and sentimental value, and they are indicators of the meaning of home shaped by the individual's homing experience (Neumark, 2013). In this sense, the migrants' feeling at home becomes possible with the help of the placement of familiar objects, such as furniture (Rottmann, 2020). The communication and interaction between man and space and humans and objects provides continuity between past, present, and future lives and cultural memory and turns a house into a home through the home (re)making process.

3. The study

Defining a space with furniture gives an opportunity for user appropriation of space. It also accelerates time-dependent processes such as belonging, familiarity, and attachment to a particular place. Since property ownership mostly disappears in the case of forced migration, the importance of furniture and other goods, such as accessories, for personalization and identification of space become clear. They also increase the effective and flexible use of space and meet users' changing needs in the short, medium, and long term. Even if the living space changes, it is possible to recall memories with the help of furniture. Due to the income status of most refugees and immigrants, it is quite crucial that the furniture have adaptable, affordable, durable, modular, multifunctional, and simple solutions

The furniture design workshop was held February 27–29, 2020 with the theme of "[Re]-making home"², and domestic furniture and complementary furniture and accessories were designed based on the priority housing needs of Syrian families living in the district of Sultanbeyli, which host the largest Syrians living on the Anatolian side of İstabul in Turkey. Multiple design proposals were developed for Syrians appropriate to their culture, habits, and needs, and proposals were designed according to four categories: *sleeping, eating, sitting,* and *storage*.

3.1. Participants

Besides one professional design expert, eight academics and designers

from Marmara University (MU), Mimar Sinan Fine Arts University (MSFAU), Altınbaş University (AU), and Istanbul Technical University (ITU) joined the workshop: two from the ITU product design department, one from the ITU interior architecture department, one from each of MU and MSFAU interior architecture departments, and three from the AU interior architecture and environmental design department attended the design workshop. Twenty undergraduate and graduate students from the aforementioned universities and departments, including one undergraduate student from the Department of Interior Architecture at Karadeniz Technical University (KTU), attended the workshop. There were two or three tutors and four to six students in each group.

3.2. Method

The method had two stages. First, ethnographic methods and the cultural probe technique were used to obtain information from Syrian families living in Sultanbeyli in Istanbul. Ethnographic methods require the researcher to spend time with a particular group for collecting data (Morgan-Trimmer & Wood, 2016) and for learning the culture of a particular setting or environment (Curry et al., 2009). The observation technique was used to obtain information regarding Syrian families' activities, behaviors, roles, and needs in their home environment. The cultural probe technique, which creates a dialogue between the designer and the user (Gaver et al., 1999) and is a useful method to get inspiration for housing (Mattelmäki, 2006), provided an idea of the Syrian family's lifestyle, habits, and needs. However, the cultural probe method-which involves user participation in the design process, and requires self-documenting- was used in combination with ethnographic method due to a language barrier with Syrians. The cultural probe method also requires participants to be literate, to communicate to fulfill the assigned tasks, and to be competent to take photos. Thus, the field photography was carried out by the researcher with the guidance of the Syrian participants. All collected data from the field study was shared through a seminar during the workshop, and all photographs taken in the home environments of the Syrian families were shared digitally on Google Drive with the workshop participants. Second, human-centered design approach, which requires a deep understanding of the people to be served, to dream up the ideas, and to create innovative solutions rooted in actual needs (IDEO, 2015), were used for developing design proposals to meet the users' needs in the design process. The design proposals were analyzed using tables, which included categorizations according to function, given names, used material, and design concepts.

3.3. Field study results

The findings obtained through the cultural probe and observation techniques revealed that family relationships, roles, and hierarchy; gender; privacy; and religious beliefs influence spatial use and organization. Syrians, who mostly belong to lower- and middle-income groups, have an extended or nuclear family structure and a crowded, sex-segregated family life. Although Syrians have large and crowded families, they live in limited spaces (i.e., small apartment flats in Sultanbeyli). The living room is the heart of the house and a common zone where many activities take place. For example, meals are eaten in the living room on a low table. Seating in the living room mainly consists of cushions on the ground, and mattresses, mostly in the bedrooms, are used for sleeping on the floor. Apart from property ownership, a family's income status affects spatial interventions. Semi-fixed or mobile furniture appropriate for frequent moving is vital in the space. Accordingly, space was organized by the placement of furniture, complementary furniture, and accessories. Multi-functional and adaptable furniture and accessories were common for limited spaces to increase their efficient and effective use, and they also served as storage, which was necessary for large households. The use of excess objects acquired in Turkey or brought from Syria can be read as indicators of self-expression or as identifying with the homeland left behind.

3.4. Process

The furniture design workshop was conducted in a studio environment. In addition to seminar regarding field findings on Syrian's culture, lifestyle, habits, and needs, two seminars³ were given by invited speakers on the first day of the workshop. The first seminar, entitled "Design and Entrepreneurship," was about designing furniture using inspiration from culture and tradition, and the second seminar, entitled "A Method for Ethnographic Approaches: Cultural Probe," was regarding the workshop method.

All digital and hard copies of the workshop materials were shared with the participants. Considering the cultural and behavioral habits, lifestyle, preferences, needs, and demands of Syrian families, the students were asked to develop a design idea; give a name to their design proposal; support their design with sketches, axonometric perspectives, detailed drawings, and 3D renderings; and make a physical model. The working scale was determined as 1/10, the model scale was 1/10 or 1/5, and the detail scale was 1/5 (1/1 if necessary). All proposals were individually designed and detailed according to the *idea/concept* development, designing, visualization, and production stages of the design process. On the last day of the workshop, the students presented their furniture design proposals in front of the jury, which consisted of the workshop tutors. The design workshop consisted of daily studies:

The first day of the design workshop started with group studies to understand the given task and to discuss the different aspects of the design problem depending on the purpose of the workshop. With the leadership of the workshop tutors, each group questioned the specific issues related to forced migration, such as migration, displacement, belonging, identity, culture, housing, and furniture. Thus, on the basis of the consensus, the factors that guided the design studies were revealed by the group members, and the defined factors were hung on the board using Post-It notes (Figure 1). At this stage, the tutors gave constructive criticism to enable students to

develop their initial design ideas using human-centered design approach based on their initial needs via faceto-face communication. On the first day of the workshop, the individual design proposals were begun using sketches, schematic diagrams and note taking.

The second day continued with the development of the design proposals. While the studies were ongoing, the group tutors examined each student's design individually and ensured the development of design proposals. In this process, the designs progressed: an emphasis was placed on sketching; the functions were clearly defined; and material, texture, and color decisions were made. The transfer of two- and three-dimension proposals to the computer environment began. In addition to detailing, the physical models began constructing at the end of the day, and the proposals continued to be developed (Figure 2).

On the morning of the third day, the students made preparations for the final jury (Figure 3). All students prepared design posters using computer and conventional visualization techniques and completed their physical models, and wrote their design statements. The students presented their work in front of the jury that afternoon (Figure 4).

3.5. Products

During the three-day furniture design workshop, 20 different furniture proposals were designed in four categories. Six proposals were developed in the *sleeping* category (Table 1). Based on the student's own opinion, the first proposal was designed to be easy to pack and suitable for Syrian refugees' frequent moving. The basic idea of the design proposal, called "compact", is to build anytime, anywhere. Designed by combining storage, bedside tables, and sleeping units in a single product, the proposal meets the Syrians' personalization needs. The second proposal, called "intricate," was designed considering the Syrians' lower income status, cultural characteristics, and large, crowded family life. The basic idea that guides the design is a puzzle. The design con-



Figure 1. Workshop: Day one.



Figure 2. Workshop: Day two.



Figure 3. Workshop: Day three.

sists of modules that can be combined and separated and allow large families to store their belongings and to sleep. The third proposal, called "*intersection*," was designed to satisfy sitting and sleeping activities considering the large, crowded family life of Syrians and their cultural needs. Suitable for day and night use, the idea behind



Figure 4. Workshop: Final jury.

Table 1. Sleeping design proposals.



the design was that each intersection creates a common story. The fourth proposal, called "*accord*," is designed to increase the sense of belonging and to facilitate the adaptation process for Syrian families. Thus, a bed unit was designed with a headboard for personalization. The furniture also provided storage and additional pull-out bed units. The fifth proposal, called "*kidzone*," was designed considering

children's different needs amid large, crowded families. Creating a personalized space for three children is the main idea of the design. Multifunctional products were developed with consideration for the floor mattress and for users' personalization needs and effective use. The sixth proposal, called "pull-out," was designed for children living in large and crowded families. The intertwining of private space and occupying little space in limited spaces constitutes the main idea of the design. Thus, a bunk bed suitable for user personalization and privacy needs was designed to serve a maximum of four children.

Five proposals were developed in the eating category (Table 2). The first proposal, called "non-boundry," was designed considering the new way of life that Syrians try to adapt in Turkey. Designed with reference to the state of being on the road and not belonging anywhere, the product was developed according to the user's needs. The second proposal, called "spacious," is designed according to the Syrians' culture and lifestyle. Designed with the shelf unit fixed to the wall, the product produces a compact solution for limited spaces with a drop-down table top that allows use at different heights to accommodate Syrian habits of eating on a low table. The third proposal, called "cloth," was designed in reference to the tablecloth used for eating on the floor. The designed product allows users to eat both on the ground and at different heights according to their preferences and cultural habits. Flexibility and lightweightness were the basic ideas and concepts that guide the design proposal as well. The idea that guided the fourth proposal, called "harmony," was to adapt to the newly settled environment by preserving Syrians' cultural habits and requirements for modern life. The product was designed to allow eating at different heights and maintaining the diverse needs of users, such as coffee tables. The fifth proposal, called "charm," was designed according to Syrians' cultural habits and large, crowded family life. The design idea, which is based on reinterpreting and modernizing the low table, is to design a transformable

modular piece of furniture consisting of three identical modules.

Five proposals were developed in the sitting category (Table 3). The first proposal, called "daybed," was designed considering Syrians' culture and large, crowded family life. The concept that guides the design is stackability. The product was designed to meet various needs, such as sofabed and daybed in one single product. The second proposal, called "transform," was designed for large and crowded Syrian families. The product was designed as an L-shaped sofa, which transforms to a double bed and is combined with a coffee table to meet Syrian families' various needs. The third proposal, called "belonging," took its strongest reference from the mother and child/baby relationship, which is one of the most intense forms of belonging and loyalty. A sofa, which can also be used as baby carry bag and pouf, was developed to strengthen this relationship and meet Syrians' belonging needs. The fourth proposal, called "unity," was based on designing compact furniture for small areas by considering Syrians' different needs. The design allows users to perform sleeping, eating, working, and sitting activities using a single module and can be used as a table, bed, sofa, and storage. The fifth proposal called "fixing" developed sitting furniture based on the concepts of moving (physical and mental), adapting (from here and previous home), and embellishing (for beautification and customization). The design can easily be transformed to support Syrians' living habits, such as lying, sitting, and sleeping on the ground. The furniture also allows users to personalize the product with their own covercloth.

Four proposals were developed in the storage category (Table 4). The first proposal, called "portage," was designed for children to carry their belongings easily, considering Syrian families' frequent moving. The main idea of the design was to keep memory and belonging alive. The product is a backpack when closed and can be used as cabinet, table, shelf, or storage when opened. The second proposal, called "belt," was designed by considering Syrians' living habits to strengthen their sense of

Table 2. Eating design proposals.



Table 3. Sitting design proposals.





Table 4. Storage design proposals.



Syrian cities, and commemorative aspects of the home left behind. It was designed as a storage unit combined with a pouf, cupboard, open shelving system, and textile storage boxes. The third proposal, called "wicker," was an open cabinet design that can be customized according to the Syrians' needs. Based on the principles of simplicity, a design was targeted to ensure children's safety around chemical substance storage. The fourth proposal, called "lego," aimed to design entertaining, multifunctional furniture for Syrian children personalization needs. The design consisted of four different and double-sided storage components with a combination of tables, poufs, and storage boxes in different colors that can also be used as room dividers.

4. Findings

The study findings based on the graduate and undergraduate student's design proposals were analyzed in three steps.

The findings regarding design decisions supported the literature that the homemaking practices of immigrant and refugee populations needed familiar ties to the values of their previous lives for familiarity, belonging, and aesthetic and emotional needs. In this scope, the furniture proposals were analyzed holistically according to main design decisions in four categories. The *sleeping* furniture proposals emphasize identity and belonging by respecting the Syrians' lifestyle, using cultural codes and behaviors as references. The eating furniture proposals sought accommodation for individual and collective needs of the Syrians through the cultural/modern dialectic, reinterpret references taken from the lifestyle with a contemporary understanding. The *sitting* furniture proposals took their references from Syrian culture, lifestyle, and their migration stories. The students considered the different usage scenarios according to individual and collective and day and night use. The storage furniture proposals that searched for the meaning of storage for meeting the needs of Syrian families, which have large and crowded lifestyles (see Table 1-4).

The findings also validated the literature that the designs met users' needs. The students designed their proposals according to the design concepts to meet Syrians' different needs and requirements in relocation (see Table 1-4). The proposals were mainly clustered around the following concepts: flexible, adaptable, customizable, compact, demountable, modular, and multifunctional. It was necessary to develop furniture proposals using these concepts considering the income of Syrians and to effectively meet users' different needs in limited areas. The concept of compactness was linked to multifunctionality and was present in all categories. The concept of adaptability overlapped the concepts of *flexibility* and *transformability* and was seen in all categories. Other prominent concepts used in design proposals were affordable, commemorative, seperable, and combined, foldable, extensile, layered, lightweight, and stackable. The concepts of affordance and lightweightness were also used in all categories, *stacking* was mainly used in the storage and seating categories, and layering was seen in all categories except eating. This situation can be explained by the increase in storage needs in the case of frequent moving and living in limited spaces, which require mobile and multifunctional furniture to meet users' various needs. The concepts of *extensile*, *foldable*, and separable and combined found their correlations in terms of developing furniture for limited living spaces in

all categories. *Commemorative* and *customizable* concepts emphasized the aesthetic, emotional, and symbolic value of furniture rather than its functional aspects. This need has been prioritized in all furniture categories. Thus, it is possible to strengthen the emotional bonds that help people belong to their housing environment, recall memories, and meet the personalization and identification needs of the users. The design concepts used in the proposals are shown in Table 5.

The findings also confirmed that the designs' adjustment capacity enabled the flexible and effective use of spaces to meet the changing needs of users. In other words, the design proposals supported the Syrians living in limited areas and with mobile lifestyles. The furniture proposals were also analyzed according to their main and secondary function, and complementary furniture and accessories. In twenty proposals developed in four categories, the main function was detailed. The proposals under the *sleeping* category included functions, including single/double bed (1-2), double bed (3-4), floor mattress (5), and bunk bed (6) furniture. The proposals under the eating category included functions, including dinning table (1), dinning/low table (2-4), and low table (2-5) furniture. The proposals under the sitting category included functions, including sofa-bed (1-2), sofa (3-4), and ground cushion (5). The proposals under the storage category included functions, including cabinet (1-3), wardrobe (2), and shelf unit (4) furniture. In the four proposals consisted of two *eating* proposals (1 and 3), one sitting proposal (3), and one *storage* proposal (3), the main functions were not supported by secondary functions. In the remaining sixteen proposals that have the secondary functions consisted of six sleeping proposals (1-6), three eating proposals (2, 4-5), three sitting proposals (1, 4-5), and three storage proposals (1-2, 4), including storage (sleeping proposals number 1-2, 4 and eating proposal number 2, and sitting proposal number 4), sofa (sleeping proposal number 3), *pull-out bed (sleeping proposals number* 4 and 6), desk (sleeping proposal number 5), shelf (eating proposal number 2 and storage proposals number 1-2), cof-

Table 5. Conceptual categorization of design proposals .

Categorization		Design Concepts																				
	Proposals	Adaptable	Affordable	Commemorative	Common	Compact	Customizable	Demountable	Extensile	Flexible	Foldable	Intersect	Interwined	Layered	Lightweight	Modular	Multifunctional	Portable	Seperable & combined	Simple	Stackable	Transformable
Sleeping	1	•	•			•	•	•	•	•	•			•	•	•	•					
	2	•		•			•	•	•	•						•	•		•			
	3	•			•	•	•	•		•	•	•			•		•					•
	4	•				•	•		•	•							•					
	5	•	•	•		•	•	•		•				•		•	•		•			•
	6					•	•	•	•	•				•		•						
Eating	1	•	•	•			•	•		•					•	•			•			
	2	•		•		•	•	•		•	•					•	•		•			
	3	•	•	•			•	•		•	•				•	•			•			
	4	•		•			•	•		•						•	•		•			•
	5	•		•			•	•		•						•	•		•		•	•
	1	•				•	•	•	•	•						•	•		•		•	•
Storage Sitting	2	•				•		•	•	•						•	•		•			•
	3	٠		•		•		•	•	•						•	•					•
	4	•	•			•	•	•	•	•				•	•	•	•		•			•
	5	•	•	•			•			•					•	•	•	•			•	•
	1	•	•	•		•		•	•	•			•		•	•	•	•	•			•
	2	•			•	•		•		•				•		•	•	•	•		•	•
	3		•				•	•							•	•				•	•	
	4	•			•	•	•	•		•				•		•	•	•	•		•	•

fe table (eating proposal number 4 and sitting proposal number 2), nesting table (eating proposal number 5), daybed (sitting proposal number 1), bed (sitting proposal number 4), floor matress (sitting proposal number 5), table (storage proposals number 1 and 4), cabinet (storage proposal number 2), and divider (storage proposal number 4) furniture. Except for the eating category, eight proposals that included main and/ or secondary functions combined complementary furniture and accessories, including bedside table (sleeping proposals number 1 and 3), headboard (sleeping proposal number 4), wall-mounted board (sleeping proposal number 5), baby carry bed (sitting proposal number 3), *pouf (sitting* proposal number 3 and storage proposal number 4), chest (storage proposal number 2), and storing box (storage proposal number 2) for accessory (Table 6).

Overall, the student's furniture proposals for Syrians using a contemporary design approach and considered that Syrian families are mostly tenants and frequently move from one place to another. They also considered the income status of Syrian families, which

Table 6. Design proposals: Main and secondary functions and complementary furniture and accessories.

Category		Func	tion	Complementary Furniture	Accessories
		Main function	Secondary function		
Sleeping	1	Single/Double Bed	Storage	Bedside table	
	2	Single/Double Bed	Storage		
	3	Double Bed	Sofa	Bedside table	
	4	Double Bed	Pull-out bed, storage	Headboard	
	5	Floor matress	Desk	Wall-mounted board	
	6	Bunk bed	Pull-out bed		
Eating	1	Dinning table			
	2	Dinning table/Low table	Storage, shelf		
	3	Dinning table/Low table			
	4	Dinning table/Low table	Coffee table		
	5	Low table	Nesting table		
Sitting	1	Sofabed	Day bed		
	2	Sofabed	Coffee table		
	3	Sofa		Stroller, pouf	
	4	Sofa	Storage, bed, table		
	5	Ground cushion	Floor mattress		
Storage	1	Cabinet	Table, shelf, seat		
	2	Wardrobe	Cabinet, shelf	Chest	Storing box
	3	Cabinet			
	4	Shelf unit	Divider, table	Pouf	

were mostly low and middle income. In this sense, most furniture proposals were designed with inexpensive and easily found materials and focused on multifunctionality. They tried to use the space effectively and affordably using compact and adaptable furniture for meeting Syrian families' changing needs and mobile lifestyles. The furniture proposals also allowed for day and night multifunctionality in different scenarios. The flexible storage capacity also finds a place in almost all design proposals, both for supporting the effective use of the space and for meeting the needs of large, crowded Syrian families. Another important design decision for furniture design proposals is to design furniture to strengthen Syrians' residential satisfaction and well-being by providing place attachment, a sense of belonging, and familiarity. To do so, the students took their references for developing design concepts and ideas from Syrian culture to transmit the cultural memory needed for feeling at home. Thus, the living habits of Syrians related to eating, sleeping, and sitting on the ground were met as a cultural reference. Another important design decision proposed in all categories was to meet the personalization, beautification, and identification needs of the Syrians. The design proposals were appropriately designed to reconstruct a sense of belonging and identity, recall memories, and display objects and items obtained here or brought from Syria. Thus, the design proposals were developed considering the following design concepts: adaptable, affordable, commemorative, compact, customizable, demountable, flexible, lightweight, multifunctional, modular, portable, separable and combined, and stackable and transformable.

5. Discussion and conclusion

Furniture meets physical and emotional needs (Proto et al., 2019) and enables users to connect with their own culture and origins. Furniture also helps meet users' personalization, identification, and belonging needs by conveying messages, displaying of self, and reflecting preferences, desires, and taste. Furniture also provides a familiar place and a homey atmosphere to users, specifically immigrant and refugee populations, such as Syrians.

At the three-day furniture design workshop themed "[Re]-making home", twenty furniture design proposals were developed by graduate and undergraduate design students from design departments of various universities in Turkey under the *sleeping*, *eating*, *sitting*, and *storage* categories with the cultural probe technique combined with ethnographic methods. Thus, new creative ideas and furniture and complementary furniture and accessories design proposals have been developed according to a human-centered design approach for Syrian refugees appropriate to their culture and needs.

The students considered the following design decisions for developing furniture proposals in the workshop:

- Respecting lifestyle, beliefs, and habits for emphasizing identity, belonging, and familiarity
- Responding to individual and collective needs of users by learning and interpreting from culture through contemporary design solutions
- Adapting to different usage scenarios and users
- Designing furniture and complementary furniture and accessories for more than one function and suitable for day and night use, frequent moving, and income status of users

- Designing adaptable, affordable, commemorative, customizable, and multifunctional furniture and complementary furniture and accessories
- Designing with inexpensive and easily found materials.

Culture, habits, beliefs, needs, crowded living style (whether extended or nuclear), income status, effective use of space, and frequent moving were the main factors considered in developing the furniture design proposals using a contemporary design approach for Syrians. This study promotes learning from users' experiences to develop need-based products with the help of ethnographic methods. This study will give insight and contribute to interior architecture, furniture design, development, and production to cultivate design ideas respectful to users' needs for furniture and complementary furniture and accessories. It will also assist immigrant/ refugee and low-income populations in making their homes with furniture for meeting their personalization, beautification, and identification (i.e., appropriation) needs. The study will also help for further research for developing design proposals regarding housing furniture prioritizing user involvement in the design process for immigrant and refugee populations such as Syrians.

Endnotes

¹ Turkey do not consider Syrians refugees. This term was used to emphasize the sociological meaning in this study.

² The workshop conducted at the ITU Taşkışla Campus in İstanbul.

³ The guest presenters for the furniture design workshop seminar were Muhammet Taşçı, the interior architect and founder of HAMM Design, and Özge Çelikoğlu, an assistant professor in ITU's industrial design department.

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Modernization initiatives and architectural instrumentalization after Nasser al-Din Shah's travels to the West (1873-1896)

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Abstract

The 19th century Iran, like other non-Western geographies had a traditional cultural, urban, social and production style. The Turkic Qajar dynasty which subordinated other local authorities in Iran in the late 18th and early 19th centuries wanted to appear on the world's global stage as a political union. With this motivation, from the second half of the 19th century, the efforts to modernise Iran gained a new pace under the rule of Nasser al-Din Shah (1848-1896) who was the first Iranian ruler visited Western Europe. Nasser al-Din Shah desired to both join the country to the modern industrial world, and in this way, open new areas of legitimacy for his own political power. In this period modernization initiatives also gave serious outputs in the built environment in Iranian cities. Tehran, in particular, was the epicentre of this transformation where many initiatives took place, seized an important step towards the end of the century in order to achieve the appearance of modern European countries as much as possible.

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Architectural instrumentalization, Iran, Modernization, Nasser al-Din Shah, Tehran.

1. Introduction

From the second half of the 19th century, during the reign of Nasir al-Din Shah (1848-1896), political, economic and cultural changes and transformations in Iran entered a new phase, and the reforms continued in different fields at various levels. In the first half of the 19th century, the Qajar state signed treaties resulting from heavy defeats against the Russian Empire and the United Kingdom (UK). The 1813 Golestan and 1828 Torkmanchay Agreements signed with the Russians, as well as the 1842 Commercial Agreement engaged with the UK, did not bring the desired outcome but generated adverse impacts on the country's economy and led local tradesmen to bankruptcy. As a result of tax exemptions, Russian and UK goods filled Iranian markets (Tahvildar, 1963; Issawi, 1983).

In this period Iran saw the inflow of foreign capital and increasing dominance of non-Muslim groups such as Zoroastrians and Armenians who played vital roles in country's fragile economy (Haji Akbari, 2015; Naibian & Silab, 2011). All those problems also made the country somehow the backyard of imperial powers (Amanat, 2019). In the following years the foreign influence on economy gradually extended and began to dominate all aspects of social life. From the early 19th century the missionary schools established by the UK, France and Russia, for example, increased their impact on the cultural life of the society (Issawi, 2009; Hamraz, 2018; Alizadeh & Hashemipour, 2019).

The most significant modernization attempts in the Qajar era and close contacts with the West took place during the reign of Nasir al-Din Shah. The continuation of the modernization initiatives in this period caused serious changes in the field of Iran's development, and it was argued by the scholars like Banimasoud (2015) that Nasser al-Din Shah's three travels to the West played an important role in the realization of these processes. While it would be reasonable to claim that the Shas's visit to Europe impacted on his vision to the westernization program he undertook, a detailed reading of the exiting archival material also suggest that limiting his modernization attempts to those visits does not

represent the whole story. Nasir al-Din Shah undertook serious modernization attempts in the urban/architectural field before his travel to the West. The construction of Arg and Mashgh squares, the opening of Sabzemeydan Square in 1852, the widening and paving of the streets inside and around Erk Castle, the opening of Almasiyeh Street with the "farangi"¹ image, the demolition of Tehran fortifications in 1868 to the expansion of the city and the dominance of new functions such as the Tekiyeh Dowlat and Şemsül-Imare buildings on the city's silhouette were among the key initiatives of Nasser al-Din Shah dated before his travel to the West. However, it can be said that these initiatives within the scope of modernization continued more rapidly and broadly after his travels to Europe. The Shah, who wanted to carry out modernization in the field of development had previously met the "farangi" image recorded in the travel books of the students traveling to the West during the Abbas Mirza period.² Nasser al-Din Shah's travels took place in the critical economic and political atmosphere of the 1870s. He visited the 1873 International Vienna Exposition, 1878 and 1889 International Paris Expositions and shared his observations in his own travelogues.

In this paper, Nasser al-Din Shah's interpretations of architectural/urban affairs in his travelogues will be taken into consideration, and how these observations shaped Shah's initiatives to re-shape built environment in his own country will be analysed. Also, this study, based on the unearthed archival material and detailed reading of primary sources, aims to understand what kind of atmosphere these initiatives created in the period when the change took place and how those attempts were instrumentalized by the political power. Nasser al-Din Shah inaugurates many of his initiatives with great ceremonies. Those initiatives had a novelty nature as well as opening up an area of legitimacy for the government of him.

Another point that should be noted is while the existing literature offers a general overview of the architecture of the Qajar period,³ those works mostly provide stylistic analysis of the architectural developments, and often miss the context where those initiatives took place and the relationship between the changes and the forces behind them. Considering this gap in the literature it would be reasonable to claim that a rigorous reading of the archival material and primary sources, such as travel books, newspapers and accounts,⁴ can portray a better understating of how the mid-19th century westernisation attempts impacted upon the morphological transformation of Tehran.

2. Architectural instrumentalization in modern state

The role of architecture in general modernisation has always been attracted scholarly attention. Foucault, in his article called 'Governmentality' claims that the modern state wants to put most things under its jurisdiction in order to survive. He also states that the modern state is based on standards, and there has never been a situation like this in any period of history (Foucault, 2011). He further claims that after the 18th century, the main purpose of modern power structures was to manage societies and architecture like many institutionalized modern phenomena, served in this direction. According to him after the 18th century, in every political discussion that sees politics as the art of governing people, one or a few chapters are devoted to urbanism, public uses, health and private architecture (Rabinow, 1984). In this respect, it would be argued that there is a dual relationship between the desire to secure the existence of the state, which is the output of governmentality, and the artistic, architectural and urban products it instrumentalises.

The phenomenon of instrumentalization of art and therefore of architecture by the political power goes back to Plato's Republic in Classical Greek philosophy (Shockley, 2015). After many versions in different civilizations, this comprehension gained pace after the Industrial Revolution, and according to John Ruskin, great architecture makes people believe in things they would not believe otherwise (Ruskin, 1905).

Coaldrake states that the interaction between buildings and the people who live and operate in them has profound effects on how authority is perceived. He emphasizes that buildings do more than supposedly serve power. "They are an intrinsic part of authority itself. One can neither be conceived nor apprehended without the other. The container and the contained are an organic whole. War and architecture were the twin preoccupations of much traditional authority, and when states and their leaders were not engaging in the former, they were indulging in the latter. As shelter is essential to life, so architecture is essential to the projection of authority" (Coaldrake, 2002).

In his article titled 'Reshaping cities: staging of political transformation' Wim Blockmans states that cities, throughout the history, were theatrical stages where political elites show their power, ideology and social practices (Blockmans, 2003).

Iran, under the reign of Nasser al-Din Shah, followed the same path, and architectural/urban products were instrumentalized by the political elite for gaining legitimacy, cultural construction and demonstration of political power. While the traditional powers in Iran used architectural/urban products for religious and political legitimacy, from the reign of Nasir al-Din Shah westernization initiatives in the architectural/urban field were added to the legitimacy factors.

In his three travels to Europe the Shah observed the developments in the West and opened a new chapter in the history of Iran. Similar to initiatives of Peter the Great in Russia or Sultan Abdülaziz in Ottoman Empire, the architecture and urban life in the cities he visited prompted the ambitious Shah to undertake similar redevelopment programme to modernise his country and transform its major cities in line with what he observed in Western Europe. In other words, the consequences of his first-hand observations did not only impact on the rapid development of various modern institutions in the country but also changed the morphology of major Iranian cities.5 The critical question here is whether Shah's proposals, as claimed in the works of many scholars, were merely the imitations of what he saw in European cities or the modernisation programme he drafted had some genuine characteristics? A detailed reading of the available material and primary sources would provide a compelling answer to this critical question.

Modernization initiatives and architectural instrumentalization after Nasser al-Din Shah's travels to the West (1873-1896)

3. Encountering the West: First travel (1873)

With the suggestion of grand vizier Mirza Hossein Khan Sepahsalar, Shah decided to travel to Western Europe to observe innovations closely (Kasravi, 1984). Starting from the Anzali Port, the Shah passed through the Khazar Sea to Russia, and then visited Prussia, Belgium, England, France, Sweden, Italy, Austria and the Ottoman Empire. On his first western travel Nasir al-Din Shah recorded observations on architectural and urban artifacts more than anything else. In all of Shah's travelogues, it is possible to see what his judgment of aesthetic taste was and how it was constructed. While he was in Russia, for example, the Shah observed the Hermitage Museum in Saint Petersburg with admiration and recorded interesting views about the building and the objects exhibitied in the museum (Nasser al-Din Shah, 1983). The museum building, with its extravaganza columns, stairs and ornaments in Baroque taste, left a great impact on the Shah as the preservation of ancient artifacts in museums was not a practice in his world. In Islam painting and sculpturing human body are forbidden, and the allocation of a building for its exhibition was an extremely alien phenomenon. The statues erected in the centre of the squares with fountains also surprised the Shah. He liked palaces, squares, treelined avenues on a grid plan and did not overlook the separateness of the carriages and pedestrian paths on the streets (Nasser al-Din Shah, 1983).

While passing to the Berlin Palace with the Prussian Emperor Wilhelm II and the state delegation the Shah was deeply impressed by the square in front of the palace, the gardens decorated with flowers, and the statues located in the various parts of the building. Gas lamps in Berlin, in particular, were a criterion of "aesthetics and development" for Nasir al-Din Shah. The church and palace around the Schloßplatz,⁶ as well as sculptures, museum and ammunition, were all new places which were not exist in his country. While Shah was visiting entertainment and recretaional venues such as the zoo and aquarium in Potsdam, he was just getting acquainted with the places where worldly pleasure took place.

The most interesting point in Nasser al-Din Shah's first European travel was his visit to the 1873 Universal Vienna Exposition with the Austro-Hungarian Emperor Franz Joseph (Figure 1). Expressing his admiration for the architecture and technologies used in the Exposition, the Shah especially visited the Ottoman, Egyptian and Iranian pavilions. The Vienna Exposition attracted the Shah's attention not only with its products, but also with its modern architectural materials such as steel and



Figure 1. Nasser al-din Shah and Franz Joseph (wikigallery.n.d.).



Figure 2. The Pavilion of Iran at the Universal Exposition of 1873, Vienna, (tehranprojects.n.d.).

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glass. The architectural style used in the Iranian Pavilion, can actually be described as an exemplary interpretation for the formation of the new extrovert street architecture of Iran (Figure 2).

Although architectural elements such as the pointed arch, windows on the side wings without an iwan, columned portico at the entrance and pediment on the façades were previously seen in Qajar aristocratic architecture, the construction of the façade in a two-storey style consisting of row windows as in the bourgeois civil buildings in European industrial cities was a new practice. For westerners who came to the Exposition, it was fun, unfamiliar and mysterious to watch the architecture, culture and products of an eastern country like Iran. So much so that Persian carpets were priced at one third of their European counterparts (Rampley, 2011).

It is possible to see that Nasser al-Din Shah exposed the "farang" impression that he got after his first travel with new initiatives in the urban/architectural field. Before the Shah's first trip, in 1872, the construction of the Almasiyeh Gate and the widening of Bab-e Homayoun or Almasiyeh Street was already started. Yet in order to give Tehran a new "farang" appearance, the authority to widen the street and new constructions was given to the state vizier Ala-od-dowleh (Etemadossaltaneh, 1877). Bab-e Homayoun, also known as Almasiye Street now had a new look.

The addition of a restaurant at the beginning of the street was particularly an important step in the formation of this new image. The decorative pool built in the middle of the pavement in front of the restaurant was similar to the image Nasser al-Din Shah saw in Europe (Shahri, 1992). The presence of realistic pictures on the door, wall and ceiling of the restaurant was an unprecedented sight in public spaces in Iranian cities until then.

Nasser-al-Din Shah actually wanted to liken Bab-e Homayoun to the streets contained shopping, entertainment, working and social organization places in European cities. However it would not be wrong to state that the construction of such a street in Tehran which had a traditional outlook was not an attempt out of necessity, but rather to

gave it a "farang" look. As a matter of fact, opening up to the global capitalist market also required an extrovert urban morphology. The pattern around Bab-e Homayoun Street consisted of Qourkhaneh⁷ Building, Nizam Madrasa, Majma-ol Sanaye School⁸ and Mahdaliya Mosque (Javaher Kalam, 1978). In other words, at this new setting military, educational, religious buildings and entertainment venues were gathered together. Military and educational buildings were facing the street was now turning the city away from its medieval identity. Turning modernization into a tool of legitimacy, the Shah wanted to show himself as a leader in technological changes, while he had led the development activities such as the inaugural of the enlargement project of Tehran in 1868. Shah opened an electrical factory built in the Majma-ol Sanaye School in 1878 and lights the first lamp with his own hand (Etemadossaltaneh, 1879). Bab-e Homayoun also opened a new area of legitimacy for the state with its image symbolizing modern education and industry. The Shah stood out not only as "God's shadow on earth", but also as a pioneering figure for the ummah, the Muslim community, to join the modern world.

4. Cultural inspiration: Second western travel (1878)

Nasser al-Din Shah's second western journey took place five years later in 1878. Although the observations recorded in the second European travelogue of Shah are similar to the first one, during his second visit Shah further emphasised on cultural affairs and lifestyle in the West (Nasser al-Din Shah, 2000).

The entertainment venues reserved for the worldly pleasures of the people of Western Europe were unknown for a country like Iran, which had a traditional cultural structure. In particular, social gatherings where men and women participated in together was a novelty for the Shah. In Iran, people socialized only in mosques where religious rituals took place, in bazaars where economic activities were carried out, and in public squares where government demonstrations were held. The structure of the streets of the Tehran were not suitable for such entertainment activities.

Modernization initiatives and architectural instrumentalization after Nasser al-Din Shah's travels to the West (1873-1896)

The most remarkable part of Nasir al-Din Shah's second travel to the West is his observations during his visit to the 1878 Paris Universal Exposition. "The entire building of the exposition is made of steel and glass... We went to the Pavilion of Iran. They built very well, the pavilions of Egypt, Tunisia, China and Japan are next to the Pavilion of Iran. (Pavilion of Iran) was really better than all... It looks like Eshratabad Pavilion. However, on the first floor there is a tiled room with a fountain poop made of marble, and then a staircase leads to the second floor, the room with a muqarnas *mirror.* They built very well, the windows and doors are all from Iran, most of the people come to see this place".

The Pavilion of Iran was made in an extrovert style, similar to its predecessor in the 1873 Vienna International Exposition (Figure 3). The tiled space in the pavilion was adapted to the taste of western people by using the fountain. Because mirror had become a popular building material since its use in the Gallery of Mirrors in the Palace of Versailles in France, the use of the mirror with muqarnas as an interior decorative element on the second floor of the pavilion was consciously chosen by the architect Hossein Ali in order to get the admiration of the audience.

Nasir al-Din Shah perceived Paris with its ferries, railways, trains, and Exposition structures in which steel and glass were used. At that time, Violet-Le Duc was chanting for the use of steel and glass: "Every age has its own architecture, and ours is the age of iron, brick and factory" (Eyüce, 2001).

On the other hand, it is important to note that when Shah wanted to transform his country in line with European fashions, Iran was experiencing an economic disaster. As noted by Katouzian (1995), after the 1870s the socio-economic crisis caused by the depreciation of silver and therefore the currency in the country and other structural problems had a negative impact on the social structure. Nasser al-Din Shah's modernization initiatives based on foreign loans.

Such drastic conditions, however, did not interrupt the Shah's modernization program. One of the vivid examples of his ambition is the replacement of the



Figure 3. The Pavilion of Iran at the Universal Exposition of 1878, Paris (tehranprojects.com).

old Otagh-e Mouzeh⁹ by a Western style museum. Etemadossaltaneh shared information about the opening of the museum in September 1879: "... A very large and excellent museum was built in one corner of the Saltanat Pavilion... The building of this museum is similar to the museums of all European states" (Etemadossaltaneh, 1888). Sharaf Newspaper described the museum which was not a familiar phenomenon at that time by sharing a picture of the building in an issue (Etemasossaltaneh, 1883).

When Nasir al-Din Shah saw the preservation of antiquities in European countries during his western travels archeology was emerging as a modern discipline in Iran. Shah showed his interest not only with the opening of a museum, but also with the preservation and repair of historical artifacts such as shrines, mosques, monuments and tombs belonging to the Turkic origin rulers and dignitaries in his own country (Etemadossaltaneh, 1878).

The Shah conducted all his initiatives delicately to obtain the satisfaction of both the people and the power layers around him by protecting the religious and sacred buildings. The news of these repair attempts was reflected in Vaghaye-e Ettefaghiyeh (NLI, 1994c). Restoring the religious buildings and places were in fact performed by earlier rulers namely Safavid and Afsharid. Repairing non-religious architectural monuments was, however, unprecedented in Iran. The Shah wanted to consolidate his lineage legitimacy by repairing the tombs of Turkic origin emperors such as Tughril Beg and the Dome of Soltaniyeh. These initiatives was placed in the newspapers with gravures. In an issue of Sharaf Newspaper in 1885 Etemadossaltaneh praised the attempt by sharing the gravure of Tughril Beg Tomb before and after repair (Figure 4) (Etemadossaltaneh, 1885a).

The most important "farangi" image that Nasser al-Din Shah brought to Tehran after his second travel was Toupkhaneh Square and the new functions around it (Figure 5). Some scholars state the construction date of the square as 1884 without citing a valid source (Javaher Kalam, 1978; Kariman 1976). However, Etemadossaltaneh recorded the construction date of the square as 1877 in the 318th issue of Iran Newspaper: "The wide rectangular square is all made of bricks and has two floors. Gunners reside on the lower floor and cannons are placed on the upper floor. A large pool was built in the middle of the square and the square was paved with stones. It is illuminated by gas lamps every night. It has six gates..." (NLI, Fixture No: DSR ۱۳۷۰--/الف), File No: 1014574). The famous 19th century traveller Ernest Orsolle (1997) defined Toupkhaneh Square as the center of the city while passing through Tehran on his voyage in 1882.

It is important to note that contrary to traditional urban spaces in Iran, Toupkhaneh Square was not dominated by minarets and domes. Qourkhaneh Building on the west side and a Imperial Bank of Perisa¹⁰ on the east side were the two major structures encircling the new public place (Figure 6).

With all new characteristics Toupkhaneh Square provided the most basic urban change for Tehran. Ala-od-dowleh, Lalezar, Chragh-e Gaz, Nasseriyeh, Almasiye and Marizkhaneh streets, connected to the square by six major gates. All this new layout shifted the centre



Figure 4. The gravure of Tughril Beg Tomb before and after repair that was pressed in the Sharaf Newspaper (Etemadossaltaneh, 1885b).



Figure 5. Toupkhaneh Square and Lalezar Gate to the northeast in 1903 (Whigham, 1903).

Modernization initiatives and architectural instrumentalization after Nasser al-Din Shah's travels to the West (1873-1896)



Figure 6. The Imperial Bank of Persia and Lalezar Gate (Fraser, 1910).



Figure 7. Abdolghaffar Najmolmolk's map of Tehran in 1891 and Toupkhaneh Square (Shirazian, 2012) [Red parts added by A. Kahraman].

of the city away from Sabzemeydan Square and the bazaar, two significant traditional urban landmarks of Tehran. The square and the streets around it was giving a modern appearance by creating a grid pattern in the center of Tehran's traditional fabric. Next to the square (Figure 7), as Etemadossaltaneh says, was "...the magnificent and very beautiful Telegraph Office Building built in western style..." another modern function (Etemadossaltaneh, 1888). ¹¹

In addition to changes occurred in macro scale in the urban grain of Tehran, by the 1880s, European baroque and rococo elements in the Qajar state/ aristocracy architecture begun to be seen. The Masoudiyeh Pavilion-Garden (1878) in Baharestan Square, the buildings in Baghshah Square (1882) and the Saltanatabad Pavilion-Garden were the examples where the new architectural tastes can be vividly seen in the changing city.¹²

Mirroring this rapid transformation the most striking event of during the Nasser al-Din Shah period was the erection of his equestrian statue in the middle of the Baghshah Square. The impressing sculpture which commissioned by the vizier Eghbalossaltaneh and made in the Qourkhaneh, the armory, in 1887, was greatly appreciated by the Shah (Figure 8).

It was recorded in the 50th issue of the Sharaf Newspaper that the Shah would reward the vizier of Korhane, the architect Mirza Aliakbar Khan who made the statue, and all the employees who contributed. Despite the fact that the construction of the statue was against the Islamic tradition, the Shah wanted to place the statue in the middle of Toupkhaneh Square like his western counterparts (Etemadossaltaneh, 1887b). However, since this action was not perceived well by the public, the Shah changed his decision and waited 18 months for the opening of the statue and chaned its location to a less visible place in Bangshah Square. Etemadossaltaneh writes that inaugural of the statue of Shah with a ceremony would have negative con-



Figure 8. Nasser al-Din Shah at the Foot of his Bronze Statue in Qourkhaneh ([Photographs of Antoin Sevruguin from the Qajar period], ca 1885-1930).

sequences (Etemadossaltaneh, 1971). The inaugural on 16 October 1888, started with the speech of the Ottoman sefir-i kebir, the grand ambassador and with the participation of other foreign ambassadors. Shah took the stage and lifted the curtain on the statue with the Salam-e Shah music (Moayyer, 1982). There was no doubt that the Shah was sure that the public, the ulama and mullahs would react against the opening of the statue. On the one hand, he wanted to use the statue to gain the image of his western counterparts, and on the other hand, he had to find a a smoother way to reduce a negative reaction from the base of the society. For this reason, he wanted to achieve his goals by moving the statue from Toupkhaneh Square to Baghshah. The speech of the ceremony by the Ottoman ambassador who was the representative of the most powerful Muslim country of the period was a strategic choice. By inviting the ambassador, the Shah wanted to diminish the potential reaction by the traditional segments of the society.

Those tactics, however, were efficent to some extent. The concessions given to foreign companies with agreements such as Reuter in the 1870s were at their peak in the 1880s. Such steps and the fundamental reforms carried out by the Shah towards westernization provoked the ulama who had an important place in various layers of society to raise their voice against the 'allien acts' of their ruler (Amanat, 2019). The unprecedent reform attempts by the Shah forced the mullahs who could harmonise the relationship between the state and the society towards the opposition block (Averi, 1994). Alarmed by those objections, the Shah was trying to find strategic steps to lessen the impacts of public opposition and address the concerns of ulama (Amanat, 2019). The Shah's careful supervision of the construction of new religious buildings, as well as the preservation of the historical congeneric ones, were among the initiatives within this content.

Under this athmosphere, the Shah started the construction of Tehran's largest mosque in 1879 at the initiative of the Grand Vizier Sipehsalar in Baharistan Square. He frequently visited the construction of the mosque. Unlike the traditional pattern, the new mosque was not built next to the bazaar in the center, but to one side of the Baharistan Square where the civil structures in the northeast of the city were located. Mirza Mehdi Khanshaghakghi and a traditional architect were appointed as architects for the mosque which took six years to build. The construction of such a large mosque in the turbulent atmosphere of the 1880s was a somewhat satisfactory undertaking for both the ulama and the public. In order to gratify the ulema's expectations, the mosque was put in service before the construction completed (Figure 9) (Etemadossaltaneh, 1885b).¹³ Shah inaugurated the mosque after the crown prince arrived in Tehran at the grand ceremony held for the opening of the mosque. On Saturday, July 4, 1885, on the anniversary of the death of Hazrat Ali, the mosque opened its doors to the congregational prayer with a huge participation of more than forty thousand people (NLI.A, Fixture No: DSR ۱۳۷۰ --- ۱۶، issue 577).

5. Fascination of technology: Third western travel (1889)

What distinguishes Nasser al-Din Shah's third western travel from the previous two is his focus on technological issues rather than cultural athmosphere in Europe. The most remarkable part of the third travel was the visit to the 1889 Paris International Exposition. The 71th issue of the Sharaf Newspaper was pressed specifically for information about the Eiffel Tower, the most influential work of the Exposition and its engineer Gustave Eiffel. (Etemadossaltaneh, 1889a).

Seeing such a large steel construction for the first time, Nasser al-Din Shah wondered with admiration the construction technique and architecture of the tower (Nasser al-Din Shah, 1992). While Shah was passing through the special railway for the Exposition, he expressed admiration that it was "a wonderful railway" and ordered the purchase of 10 similar wagons and the construction of a four-league railway in Tehran (Nasser al-Din Shah, 1992).

As noted in different parts of the travelogue, although the Shah carefully followed the developments in the West, he never abandoned his sensitive approach to conservative values. One of the most interesting examples of this approach is a Qur'an sold in the Indian pavilion in the exposition. The Shah was displeased that such a holy book was being sold at the exposition as a priced product, and ordered the Qur'an to be bought and removed from the shelves immediately.

Among the most remarkable products in the exposition were the pavilions representing the most popular approaches taken by various countries. The architectural style used in the Iranian pavilion was different from the pavilions in the previous expositions. The combination of arch, dome and plaster used in the pavilion refers to the façade elements found in the pre-Islamic architectural monuments of Iran (Figure 10).

In particular, the reconstruction drawings of Achaemenid and Sassanid monuments created by Aryanist orientalists such as Eugene Flandin, Marcel Dieulafoy and Charles Chipiez were used in the design of the pavilion. The combination of the arch and the dome of the pavilion featured the Sassanid work of the Sarvestan Palace, and the repetitive serrated elements in the entablature recall the stair railings in Persepolis.

The image of the pavilion's architecture was a good opportunity to exhibit and promote the "image of ancient Iran, strong and civilized" passionately fostered by Western Orientalists in the fields of history and archaeology. Today, it is possible to observe that the pavilion not only exhibits commodities from



Figure 9. While the Nasseriyeh Mosque was being built, it was the headline of the Sharaf Newspaper. (Today's name is Sepahsalar Mosque) (Etemadossaltaneh, 1885c).



Figure 10. The Pavilion of Iran at the Universal Exposition of 1889, Paris (Library of Congres, 2021).

Iran, but also acts as a kind of a harbinger of the Iran's new path in the pursuit of nation-state and identity. It should also be noted that the façade revivalism of the Achaemenid-Sassanid architecture used in the Iranian pavilion was not the first example representing this attitude. In the 1880s, Achaemenid-Sassanid architectural revitalization was tried in the residences of the Kavam family who was an aristocrat of Jewish origin in Shiraz (Grigor, 2016). However, the implementation of the Achaemenid-Sassanid revivalist style in a building that represents the state and the country on an international platform such as an exposition was an important act in this sense. Unlike the 1873 and 1878 pavilions, the Iranian pavilion of 1889 does not reflect the Qajar architectural culture of the 1880s and fed by the norms drawn by the Orientalists as noted above.

In the 1880s the pavilions built by Nasser al-Din Shah in Arg Government Castle and some other locations in Iran consisted a dual identity representing both the European neo-classical revivalism and local architectural elements. Andarouni¹⁴ pavilions such as Emarat-e Khabgah¹⁵ in Farah Abad is a good example in this context. The pavilion which was built on April 3, 1887 inspired by the Dolmabahçe Palace's plan in Istanbul (Moayyer, 1982; Etemadossaltaneh: 1888; Etemadossaltaneh, 1889b). It is possible to mention the Obeyz, Melijak and Yaghout pavilions among other structures built in a similar style of the period.

As a result of all those cultural interaction with the West and other local dynamics by the 1890s, the last six years of Nasir al-Din Shah's reign, the urban pattren and silhouette of Tehran changed dramatically. The modernization of the image of the city and the construction of modern functional buildings in accordance with the needs of the capitalist economy in order to establish good relations with the European states were the areas where great changes took place towards the end of the century.

It is possible to see the changes that the Shah made in Tehran during his reign on the Tehran Map prepared in 1891 together with Abdolghaffar Najmolmolk and Dar ul-Fonun students (Figure 7). The flat and wide streets connecting to Arg Government Castle and Toupkhaneh Square and the formation of new districts such as the Dowlat in the north greatly change the concept of neighbourhood in the city.

As can be seen from the map, the plan of the city has an octagonal shape formed by the walls around it. The connection of the city to the outside is realized through 12 entrance gates. Through these gates, the main core of the city could be reached directly. The transportation from the developed neighborhoods in the north of the city to the old center was through large squares and streets leading to these squares. In the north, the Nasseriyeh Mosque, Shams ol-emareh, the Tekyeh Dowlat and other public buildings gave a new look to the new silhouette of the city. The application of extroverted architecture around the new streets in line with the style of Western European cities also created a new look against the old fabric.

The rapid growth of the city, its population reaching up to one hundred thousand, and the increase in the streets for vehicular circulation required public transportation. The Shah took an important step for public transportation by giving the authority to establish the Horse Carriage and Bus Company to a state official named Mirza Javad Khan. With the purchase of 30 cars from Russia, on November 5, 1890, stations began to be established next to Toupkhane Square, Sebzemeydan and the British consulate building (Issawi, 2009).

With all his attempts, Nasir al-Din Shah was closely related to the status of the advanced industrial countries of his age. While following the developments in Western Europe with admiration, he failed in many reforms as a result of both his own conservatism and the pressure of the ulama. As a result of large loans and the economic crisis, an agreement made with the Talbot Company in 1890 was to monopolize the production and sale of tobacco in Iran for 50 years. This situation led to serious revolts against the government led by the ulama throughout the country. Meanwhile, the Shah invited the cleric Jamal al-Din al-Afghani who had gained great fame in the Islamic world at that time to the country in order to preserve the legitimacy of the state. However, when the Shah found Afghani against him, he ordered the deportation of Afghani and cancelled the agreement with the Talbot Company with the fatwa of Mirza Hasan Shirazi, one of the foremost ulema of the time.

It is possible to say that this issue caused the ulama to gain serious power against the Qajar state, and it also created significant obstacles against the Shah's reformist initiatives such as Dar ul-Funun. Nasser al-Din Shah died on April 30, 1896 as a result of an armed assassination by Mirza Reza Kermani, one of the followers of Afghani (Teimouri, 1979; Amanat, 2019).

6. Conclusion

The outputs of the initiatives in the urban/architectural fields in the second half of the 19th century significantly transformed parts of Tehran into the appearance of industrial cities in Western Europe. These changes occured during the period of Nasser al-Din Shah, especially starting from the 1870s.

Although the Shah had some information about the image of Europe before his western travels, he undertook new initiatives based on his observations during those visits. These include having his own equestrian statue built even though he could not erect it in the centre of the city, the dominance of new functions such as a bank, Telegraph Building, Oil Lamp Factory and Qourkhaneh Building around newly constructed urban squares and streets. In addition, initiatives to protect historical artifacts as a modern practice are among the activities within this context.

The participation of the Shah in the largest expositions of the century in order to promote his country in the international arena and to obtain the appearance of modern Western civilization was again realized by the instrumentalization of architectural products.

While the Shah realized his desire to include the country in the contemporary global trade economy, he used these initiatives to ensure the legitimacy of his own power. In order to achieve his goals the Shah conducted a successful public campaign and used newspapers to promote his ambitious acts. In line with the modernization attempts, and considering the expectations of different social groups in the society, the Shah also took symbolic actions such as the construction of the Nasseriyeh Mosque, to show his respect to the traditional values.

Neither the bitter economic burdens demanded heavy foreign loans nor the objections from the conservative circles prevented the Shah to undertake his ambitious reforming program. The best proof of this was the process that took Tehran to gain a contemporary appearance which is emphasized in this study. Towards the end of the 19th century, Tehran took a contemporary look with grid planned wide streets, modern buildings, squares, green spaces, extrovert buildings and paved roads with horse-drawn carriages. And all those works paved way for more comprehensive change that would be occurred in the first half of the century in Iran conducted by Pahlavi rulers under a different political setting.

Endnotes

¹ 19th century Persian term used occasionally to describe Western Europe.

² For detailed information about Abbas Mirza period travelogues, see (Aboutaleb, 1973); (Elchi, 1985); (Shirazi, 1968); (Afshar, 1970).

³ For detailed information, see (Banimasoud, 2015); (Ghobadian, 2015); (Habibi, 2007); (Nazari & Nikzad, 2007); (Hamidi & Sabri, 1997b).

⁴ The Entebaat Vizier was the one who was responsible for the printing and publishing works of the state.

⁵ For detailed information, see (Banimasoud, 2015); (Ghobadian, 2015); (Habibi, 2007).

⁶ Central historic square of Berlin

⁷ Qourkhaneh (مناخروق) a word of Turkish origin means the place where military equipment is produced.

⁸ Majma-ol-Sanaye School was an education center opened for teaching science and art branches within the framework of modern education discipline. It is important in terms of being the second education center where modern disciplines were trained after Dar ul-Funun School. For detailed information, see (Yousefifar, 2011); Etemadossaltaneh stated the professions taught in Mecme-ül Sanayi School (Etemadossaltaneh, 1888).

⁹ Room of Museum

¹⁰ Imperial Bank of Persia was opened in 1889 after the third travel of Nasir al-Din Shah (Zoka, 1970). The bank building, which started to work as the first modern banking center in Iran, was later demolished under the Pahlavi regime. For detailed information about Toupkhaneh Square in the Qajar period, see (Curzon, 2017); (Orsolle, 1997); (Jackson, 1976).

¹¹ The mentioned Quorkhaneh and Telegraph Office Building in Toupkhaneh Square were deliberately demolished under Pahlavi regime.

¹² Information about these three urban monuments is only limited in historical documents, as they were deliberately demolished under the Pahlavi regime.

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¹³ It was stated in the Sharaf Newspaper that the construction of the minarets and the dome, which are the two essential elements of the mosque, was not finished.

¹⁴ Andarouni mansions were the places where Nasser al-Din Shah led a private life with his harem.

¹⁵ The pavilion was deliberately demolished under the Pahlavi regime.

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An analysis of heterotopic space: Hasanpaşa Gazhane, enlightening once again

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Abstract

While architectural structures are being physically damaged over the years, they may also become functionally inadequate as a result of the change and development. At this point, re-functioning works transform these structures, which are valuable in terms of both social memory and cultural heritage, into structures that also respond to spatial needs.

Factors that require re-functioning such as technological variables and societal changes that occur due to population growth are based on the differentiation in user needs. These changes do not always arise out of necessity, but sometimes they are necessary to create regional radical changes due to management strategies.

Foucault talks about the concept of heterotopia in his work titled "Of other spaces". The scope of these structures, in which the conflict of old and new is felt and unplanned energy is released, has been the subject of various studies and equivalence of various examples to the concept of heterotopia has been researched.

This study was born from the idea that some re-functionalized buildings make user feel the old and new function at the same time, and in Foucault's words, the user gets exposed to other space experience. As a sample, Hasanpaşa Gazhanesi, located in Kadıköy, was chosen to be examined. In the research, the findings were examined with hermeneutic method by using general resource search model and documentary resource search model, which are among the qualitative research methods. It is aimed to make 'heterotopic' evaluation of the chosen space and to examine the concept with concrete example.

Keywords

Hasanpaşa Gazhane, Heterotopia, Michel Foucault, Museum Gazhane, Refunctioning.

1. Introduction

In his book named 'Of Other Spaces', the 20th-century social theorist, critic, historian, and philosopher Michel Foucault states that "space itself has a history in Western experience, and it is not possible to disregard the fatal intersection of time with space" (Foucault, 1984). Foucault presents the 19th century as an epoch of time and the 20th century as that of space. Heterotopic spaces are of characteristics such as accumulation of time and temporariness. In his book "Poetics of Space", Bachelard establishes the relationship of space with time as follows; "In its thousands of honeycombs space holds time as compressed. Space serves that purpose" (Bachelard, 2014).

Though the ambiguity of the concept induces its examination from incompatible angles, heterotopia has a strong relationship with the concept of 'time'. In this regard, we aim to explain the state the concept causes in the user, that is, as Foucault puts it, the 'other self' emerging through heterotopic space.

The ambiguity of certain aspects of the concept improves its scope and makes it open for the hermeneutic analysis, which is what Foucault expects from research. In this context, this study evaluates the re-functionalized Hasanpaşa Gazhane as a heterotopic space.

The present paper has three sub-sections. The first part looks into the concept of heterotopia and its relationship with space. We review the hitherto literature as well as the works of Foucault who, referring to the heterogeneous structure of the space, puts that "The space in which we live, which draws us out of ourselves, in which the erosion of our lives, our time and our history occurs, the space that claws and knaws at us, is also, in itself, a heterogeneous space" (Foucault, 1984). Upon exploring the utopic spaces, heterotopic spaces, and the scope of heterotopic spaces, it is aimed to determine the characteristics of the concept via Foucault's six principles by which he defines heterotopic spaces.

In the second part; the historical background of Hasanpaşa Gazhane, located in Kadıköy of Istanbul, and the findings obtained from the documentary research about its old and new functions are presented. The path followed in re-functionalization, governmental strategies, and the results of the process are examined in this section. Then, we proceed to evaluate the reflections of governmental strategies facilitating the aforesaid variables both at the urban scale and at the scale of the structure.

Finally, in the third part; Hasanpaşa Gazhane structure is examined through the concept of heterotopia. The old and new functions of this structure are evaluated with reference to the spatial symbols it has established. What makes Hasanpaşa Gazhane an interesting case for this paper is that the structure has witnessed various historical periods and even economic models; and that it has become a heterogeneous space as a result of the overlapping of the symbols of its old and new functions. Despite preserving the structure of its former function, it has undergone a significant change in terms of its functionality as a result of re-functioning, and it has now been planned to serve as a museum; which leads us to consider the structure as a heterotopic space.

Two separate methodologies are employed in this study; the general survey method, which is a qualitative method, to examine the concept of 'heterotopia' developed by Foucault, and the documentary research method to obtain information about the structure. We adopt the hermeneutic methodology, suggested by Foucault himself, in interpreting our findings. Derived from the Greek word 'hermeneuein' meaning interpretation; this method consists of informing, translating, explanation and paraphrasing (Fırıncıoğulları, 2016). The concept of heterotopia is still open to interpretation, and it is analyzed through various examples. Thus, in the light of our findings, we aim to examine and interpret the concept with the hermeneutic methodology.

In the conclusion part; we discuss that Hasanpaşa Gazhane epitomizes the concept of 'heterotopia'. Through evaluation of the concept and examination of various cases, it is aimed to develop an idea regarding the scope of the concept of heterotopia. Considering that there are other buildings with similar characteristics as the case of this study, we aim to do sociological evaluations of different spaces upon confirmation of our hypothesis. We also aim to raise awareness of Hasanpasa Gazhane which is located in one of the central points of Istanbul. Through our findings, we seek to open up a field that benefits future research on the buildings that may epitomize the concept of heterotopia.

We base our research on 'Of Other Spaces' by Michel Foucault, which we discuss in the literature review of the present paper. We then proceed to review 'The Order of Things' in which Foucault mentions the concept for the first time, and his other works where he explains his views regarding space. The works of Gaston Bachelard, whom Foucault draws on in evaluating the space, as well as various articles and books including those which review Foucault's views on architecture and spatial arrangement are also examined.

2. Heterotopia and space

Working mainly on biopolitics, Michel Foucault's studies on space developed around institutional buildings. Having written numerous works on government strategies and biopolitics, Foucault explored heterotopias through the concept of space in his article "Of Other Spaces", which he wrote in 1967 and published in 1984. Heterotopia, which is originally a medical term, is also used in fields such as zoology and botany. With its use in the realm of medicine in the 1920s, the term signifies abnormal parts in the tissue, abnormal position of the organs, abnormality in structure or formation (Yıldırım, 2020).

Foucault was the first to use the concept with a philosophical attribution. He uses the term in the preface of his book named 'The Order of Things' (2001). Holy places, which had strictly drawn lines in medieval spaces, are gradually, albeit not completely, freed of this influence in contemporary space. This has resulted in the intertwining of the sites, which leads to the emergence of certain contrasts in the space.

Foucault interprets contemporary space as follows: "In a still more concrete manner, the problem of siting or placement arises for mankind in terms of demography. This problem of the human site or living space is not sim-

ply that of knowing whether there will be enough space for men in the world - a problem that is certainly quite important - but also that of knowing what relations of propinquity, what type of storage, circulation, marking, and classification of human elements should be adopted in a given situation in order to achieve a given end. Our epoch is one in which space takes for us the form of relations among sites" (Foucault, 1984). Heterotopia is a real space in Foucault, even though it contains certain rituals and closures of its own. This real space either represents something or contests something, or inverts something in the existing social order. The point that should be emphasized is that although Foucault talks about rituals and festivals, heterotopia is basically a space for him (Çavdar, 2018).

This contradictory state of the space is reflected on the user in certain ways, and the subject which is at the center of Foucault's work on biopolitics remains inseparable from the concept at this point. Referring to Bachelard's work on space, he puts "He has taught us that we do not live in a homogeneous and empty space, but on the contrary in a space thoroughly imbued with quantities and perhaps thoroughly fantasmatic as well" (Foucault, 1984).

Examined etymologically, heterotopia is a combination of the words topos meaning place and hetero meaning different. It is used as 'other place', 'alternative place' or 'different place' in Turkish. Foucault, as a result of modernism, evaluates the space, where humane elements are stored and networks of relations are established, under a separate title that contrasts with other spaces. Under this title are two types of space: Utopias and heterotopias. This approach has been discussed in several studies, and the concepts have been improved by various researchers. This abstraction was not needed in the pre-modern era of human history to define the space which, with modernism, began to be perceived and defined not with the definition of the void it contains, but with its conceptual structure (Nalbantoğlu, 2008).

According to Foucault, utopias are sites with no real place (Foucault, 1984). Utopian spaces, being contradictory and defined as strange, completely move

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away from reality through the perfection of both society and space. Leading to the creation of the perfect, and a standard subject, utopias also induce controlling or excluding the imperfect. From this point emerges another type of space, namely heterotopias, which are completely real yet reveal uncontrollable energy. Although heterotopias are completely real, they have an ambiguous effect. They are ambivalent and they create multiplicity.

As Kaymaz puts it, "The other space is in the mind, in the experience; therefore, it has an ambiguous and unstable context in relation to the body. The other space is a kind of multiplicity even for a single body, and the conditions that make up this multiplicity are changeable and temporary. Created with different meanings depending on the way the bodies experience it, the other space is problematic, controversial and not finalized" (Kaymaz, 2017). Building the relationship between space and subject, heterotopia is a space of contradiction. The subject gains an unplanned experience in the heterotopic space. With the concept of heterotopia, Foucault asserts that the space creates duality for the user. There is an 'other self' indirectly created by the space. 'Mirror' is given as an example of the heterotopic state that reveals the 'other self'. The similarity between heterotopias and the mirror is derived from the reflection of the subject in the mirror. Apart from the space that the user occupies for the time being, there is the other space where the 'other self' is present. This contrast between the real and the unreal leads the user to perceive the heterogeneity of the space. The mirror is, therefore, an example of heterotopia, and this is the expected effect of heterotopic spaces on the user. "The space one occupies is both real and virtual, and this leads to the dislocation. The person is actually where they stand, yet the mirror causes the overlapping of real and virtual space. Therefore, the reflection in the mirror can be expressed as dislocation and shifting as a heterotopia" (Toprak, 2018). Varying with social changes, the heterotopic space preserves its authenticity due to its intertwined sites and its relationship with time, and has an unplanned effect on its user by acting as a mirror. Thus, the dichotomous energy of the old and new emerges as the other space. Heterotopias that reveal this energy and create an effect that is undeniably different from other spaces are examined by Foucault under six principles. Below we explain these principles.

The first principle is that, besides there is not a single standardized heterotopia, every culture creates its own heterotopia in a sort of way. This principle can be evaluated as divided into heterotopias of crisis and heterotopias of deviation. Crisis heterotopias can be exemplified by groups such as adolescents, women, and the elderly. Both necessary and forbidden places reserved for people who are likely to behave out of the norm (menstrual periods, honeymoon, old-age crises, etc.) are examples of crisis heterotopias. Deviation heterotopias, on the other hand, can be exemplified by prisons or psychiatry clinics, where people with deviant behaviors are intended to be closed and fixed.

The second principle is that society can make a heterotopia function in different fashions in accord with its synchrony throughout its history. Cemeteries that used to be placed near the church before the 19th century, yet were afterward removed from the city, epitomize this principle. "This major theme of illness spread by the contagion in the cemeteries persisted until the end of the eighteenth century, until, during the nineteenth century, the shift of cemeteries toward the suburbs was initiated. The cemeteries then came to constitute, no longer the sacred and immortal heart of the city, but "the other city," where each family possesses its dark resting place." (Foucault, 1984)

The third principle is the juxtaposing of several spaces that exist in a real place but create a kind of multiplicity, such as cinemas or theatre places. It is a type of heterotopia that creates a combination of places that are impossible to overlap and brings together the physical space and the fictionalized space on the stage.

The fourth principle suggests that "Heterotopias are most often linked to slices in time - which is to say that they open onto what might be termed, for the sake of symmetry, heterochronies. The heterotopia begins to function at full capacity when men arrive at a sort of ab-

solute break with their traditional time" (Foucault, 1984). Toprak (2018) defines heterochronies as follows: "Heterochronic spaces: The coexistence of different life experiences" (Toprak, 2018). This principle can be exemplified in two different ways. Museums and libraries accumulate time, however, by staying out of time, they store different times in a defined space. The second example is the reverse of the first one. Temporary festivals, fairs, and exhibitions continue their temporary existence in places where they are located. Therefore, they can cause a temporary disconnection from space and time.

The fifth principle can be defined as spaces with an opening and closing system. This principle can be exemplified in two different ways. In the first, entrance and exit are subject to full control or permission, as in prisons. In the second case, entry is not permit-required, yet access to the whole place is not possible, either. Certain sites are accessible, and an illusion is experienced. One must either be in that place mandatorily just as in barracks and prisons; or necessarily fulfill the rules and rituals and gain permission to enter as in hammam and sauna. In this category, another framework is outlined, implying architectural structures that exclude when including (Şentürk, 2015).

The sixth principle lies in having two different characteristics. "The role of the heterotopia is either to create a space of illusion that exposes every real space, all the sites inside of which human life is partitioned, as still more illusory; or, on the contrary, to create a space that is other, another real space, as perfect, as meticulous, as well arranged as ours is messy, ill constructed, and jumbled." (Foucault, 1984). With this principle, we have heterotopias that let us face the fact that the current space we live in is indeed an imaginary fiction on the one hand, while we have heterotopias that are illusory spaces detached from the context on the other.

Even though the concept is defined in general terms with the six principles above, these explanations have also raised new questions. However, because certain points were left ambiguous by Foucault, other researchers have attempted to answer these questions. For this very reason, the concept of heterotopia, the philosophical basis of which was improved by Foucault, has been discussed in numerous studies.

In the following section, we present the historical background of Hasanpaşa Gazhane, as well as its new function today, and we discuss the physical factors that provide heterochronic characteristics of the structure.

3. Hasanpaşa Gazhane

When buildings are no more functional, or when it is thought that they would be more beneficial should they have new functions in accord with the necessity of the time, re-functioning comes into play particularly for the historic buildings. When these structures, which have witnessed history, continue existing only by being protected and without being re-functioned, that is to say, when they cannot meet the functionality that is expected from any architectural structures; they turn into sculptural works.

The fact that it has a heterogeneous and original structure, and creates spaces of otherness, makes the re-functionalized Hasanpaşa Gazhane an interesting case for this paper. Being reintroduced to the district and city dwellers, the structure was brought into use as Müze Gazhane (Museum Gazhane) in July 2021.

Gazhane is located in Hasanpaşa neighborhood of Kadıköy district which consists of 21 neighborhoods and is located in the Anatolian side of Istanbul. It is known that a trade colony called Harhadon was established in Fikirtepe by the Phoenicians around 1000 BC. In this period, Kuşdili Creek had the form of an estuary and the shoreline was, compared to today, much more inland between Fikirtepe and Hasanpaşa (Kadıköy Municipality, 2021). Hasanpaşa was surrounded by Ünalan in the north, Zühtüpaşa in the south, Acıbadem in the west, Fikirtepe in the east and Eğitim neighborhood in the south-east. Having been home to numerous important structures from the past to the present, today the neighborhood still has significant structures such as Kadıköy Municipality, Tarihi Salı Pazarı, Hasanpaşa Gazhane, Karikatür Evi (Cartoon House).

As of the date we conducted this research, the population of the neighborhood was 15.241 which composed 3.32 % of the whole district. Today, the majority of the population is between the ages of 25-44, consisting of 5.492 people, making up 36% of the population in Hasanpaşa.

One of the most significant architectural structures in the neighborhood is Hasanpaşa Gazhane which is located in Hasanpaşa Neighborhood of Kadıköy District, on block 486, parcel 60. Holding an important place in social memory, as well as being an industrial heritage, this structure has been discussed and studied in various works since 1993.

Hasanpaşa Gazhane was established in 1892. Founded to meet the gas need of the Anatolian side, the building became the largest gas production center of the region at that time. "Havagazı Company, which then operated Kadıköy Gashouse in Hasanpaşa, merged into IETT (Istanbul Electricity, Tramway and Tunnel General Management) in 1945, and operation of busses was commenced in 1947 to back up the trams that were already in use of public transportation." (cited in Mazbaşı Berktay, 2012). Technological developments around the world, population growth, and different ways of energy provision have caused the gas plants to cease functioning in Turkey. Transition to the heating system with natural gas in Istanbul made air gas redundant and Hasanpaşa Gazhane began to serve as the storehouse and bus garage of IETT. Not only in Turkey but also in many parts of the world, efforts have been made to re-function gas plants, since they are generally located in centers and they signify the cultural heritage. "In European countries, mostly in the early 2000s, numerous gasometer buildings were restored, functionalized and reused" (Büyüktaşkın & Türkel, 2019).

In 1948, two furnaces were added to Hasanpaşa Gazhane. With its furnace capacity being increased, this significant structure of the Ottoman industrial heritage of the late 20th century became a facility measuring 31,495 m² by 1957. Becoming more functional due to new furnace batteries and devices for gas purification, the building came to have a production capacity that could meet



Figure 1. 2021 Hasanpaşa population age distribution chart.



Figure 2. Museum Gazhane Plan, Author, 2021.

more than the gas need of the Anatolian side in that period (Büyüktaşkın & Türkel, 2019).

Today, the structure is administered by Istanbul Metropolitan Municipality. The re-functionalization project of the building was approved by the Istanbul Regional Board of Protection of Cultural and Natural Heritage with the decision no. 6091 dated 22.06.2001. This project, dated 2001, had such functions as a playground, atelier, energy center, and library. That being said, because a construction drawing was required, the drawing of the project was contracted out by the Historic Environment Protection Directorate on 15.03.2012 (Sarp, 2013). Given the absence of an investor to undertake the implementation of the project at the time, the project manager Gülsün Tanyeli summarizes why they



Figure 3. Preliminary project dated 2001, Gasometry structures, İstanbul Municipality Archive.

did not draw the construction drawing in those years as follows: "Although we were asked for a full construction drawing at the first stage, we said that we could design a preliminary project. There were also very good reasons for why we started with the preliminary project, and today's circumstances show that we were right. There was no investor!" (Mimarizm, 2008). In the preliminary project and the works carried out afterward, the structures in the facility were preserved and no reduction was made. One of the three gasometers in the structure was designed as a multi-purpose hall with a capacity of 550-600 seats. A lot of work has been done with the collaboration of the municipality and the protection board to preserve the building with only minimal interference.

Due to its central location and spaciousness, as well as its significance as industrial heritage, the building has been the subject of many debates since its closure. In addition to various proposals put forward on what its new function should be, i.e. being demolished and used as a green space, being converted into a car park, used as a museum, or even converted into a university building, the prospective investor to the building and their request have also contributed a further dimension to the discussions. Changes in government strategies have brought about certain adjustments that have been carried out within the project. Furthermore, even though functional changes were to be determined by government strategies, Gazhane Environmental Volunteers consisting of the locals and/or followers of the project, were also involved in the process in terms of both the new function of the building and the post-construction government strategies.

In comparison to the past, today the population of Hasanpaşa neighborhood has increased, and undergone a sociological change. Likewise, the traffic density of Kadıköy is also a determinant of the alternatives to be brought to the district. Transportation to and from the building was to be planned, and parking space for visitors with private vehicles also posed a significant problem for Hasanpaşa. In an interview she gave in 2008, explaining the necessary steps to be taken to ensure this dynamics in project development processes, Gülsün Tanyeli suggested that they aimed to ensure the visitors reach the building from every corner of the city without being stranded in the traffic of Kadıköy as far as possible, and to this end, they wanted the land of IETT, which is located across Gazhane, to be brought into service as a parking lot; and she added that to increase the value of the project was only possible by ensuring that people can easily reach Gazhane by either their vehicles or public transportation. (Mimarizm, 2008).

The structure was designed as a 'Socio-Cultural Facility Area' in the Kadıköy D100 South Revision Zoning Plan with 1/1000 scale dated 14.04.1999-03.04.2006, which is in effect today. Having been re-functioned as the Climate Museum and Cultural Center, Hasanpaşa Gazhane was opened for use in March 2021. Being opened to the public under the name of 'Museum Gazhane' in July 2021, Gazhane currently has a cartoon museum, climate museum, Prof. Dr. Afife Batur Library with 10.000 books, indoor and outdoor exhibition areas, study areas, Istanbul bookstore, cafes, and performance studios.

The re-functioning processes of such symbolic buildings and the decision-making in these processes are determined by government strategies, and they have an important place in terms of adaptation to social synchronization; which leads us to examine our case within the framework of the concept of heterotopia. According to Foucault; "society, as its history unfolds, can make an existing heterotopia function in a very different fashion; ... the same heterotopia can, according to the synchrony of the culture in which it occurs, have one function or another" (Foucault, 1984). Based on this discourse, the first function of Hasanpaşa Gazhane, which was

once an important industrial building, became unnecessary with the development of technology, thus leading us to evaluate it as a heterotopia.

4. A heterotopic evaluation of Hasanpaşa Gazhane structure

In modern societies, it is seen that the social characteristics that change due to various factors and the management of these characteristics through government strategies are also effective in the decisions made regarding the spaces. According to Elden, "Foucault makes the issue complicated; he states that the current practice is mostly about the bodies in that place and that the variables of the district are aimed at dwellers of the district" (Elden, 2012). These variables emerge in large- or small-scale structures with the characteristics we see in the six principles defined by Foucault. The heterochronies mentioned in the fourth principle are spaces that accumulate time. These spaces were analyzed under two separate types. While the first type of heterochrony stores time, the second type, on the contrary, is temporary. We evaluate the case of this study, Hasanpaşa Gazhane, based on the first type of heterochronies. "This characteristic is that heterochronies start working properly when people break away from traditional time. The meaning of traditional time is not fully explained, yet it can be interpreted as the time being experienced in terms of individuals and as a historical process in terms of societies." (Toprak, 2018).

Associating the fourth principle with the concept of time, Foucault (1984) cites museums and libraries. Spaces that store time, albeit storing the past time, such as museums and libraries, exist by being exempted from time and its destruction. They bring the user to the point of breaking with what Foucault calls 'traditional time'. This creates a dual situation for the user. Creating a dichotomy between the current situation and the past, these spaces are heterotopic.

Bachelard, to whom Foucault refers in his work, defines the connection of the mentioned breakpoint with space as follows; "Indeed, dreaming is a completely formed state from the very first moment. Although how it begins is never seen, it always begins the same way: fleeing from the nearby object, immediately moving away, being in another place, in the space of another place" (Bachelard, 2014). It is thus possible to reach the space of another place in heterotopias. It is a perception of time and space, which is not entirely imaginary like utopias, yet not singular, either.

The coexistence of different experiences and the time accumulation, that is to say, the characteristics that cause a break with time; are also seen in the examples of the re-functionalized structures that have sufficient determinants. Having witnessed different epochs, the buildings with symbolic features are functionalized in accord with the synchrony of the society. These buildings bear a lot of information about the epoch, mainly thanks to possessing the architectural elements of the time, their intended functions, and even the location where they were built. When renovated in accord with the preservation rules, even if it is not in use, a building stores time yet in a sculpture-like state. Should the building not only be renovated but also have a function in accord with the necessities of the day, that is, the social synchrony, then it is capable of detaching its users from traditional time.

Hasanpaşa Gazhane structure was built in 1892 to meet the electricity need of the district and was planned in accord with the technological conditions and the population at that period. The fact that the gasometer buildings, storage areas, chimneys, and similar



Figure 4. Gasometry structures, Author, 2021.
buildings were no longer necessary in the conditions of 1993 rendered the building inactive. Many of its architectural symbols being preserved today, the structure has been re-functionalized as the Climate Museum and Cultural Center under the name of Museum Gazhane, and it continues existing in a central location of Hasanpaşa in an area of approximately 33.000 square meters.

The largest of the three gasometers in the building was opened in 1961, and used until the closure of Gazhane. Today, it is in use as the parking lot of the structure. Serving the needs of the new function of Gazhane, cylindrical steely gasometers have preserved their physical structures. The second gasometer, one of the buildings built in the first years of the construction in 1891, is in use as an exhibition and activity hall within Museum Gazhane. The third gasometer serves as a multi-purpose hall (Figure 4).

The structure, due to the above-mentioned features, epitomizes what Foucault expresses by the accumulation of time and holding experiences together. The building, which can be considered heterochronic, corresponds to the fourth principle when evaluated both with its symbolism and with the spatial perception brought about by its new function. The state of museum culture of the 19th century that accumulates the knowledge, tastes, and habits of various times and that creates duality for the user by presenting these indicators in traditional time can be analyzed as heterotopia.

Acting as a mirror due to its symbols such as gasometers, chimneys, etc., the structure, as Foucault puts it, provides a transition from the space where the users are present in traditional time to the 'other' spaces of the past.



Figure 5. The second building of the Climate Museum, Author, 2021.

There is a two-section climate museum inside the building which preserves both its current state and the characteristics of its previous function. Symbols of the previous function of the structure are kept in both sections. The second section of the Climate Museum is located in a building that was previously used as a cleaning facility where filter silos, pipes, tar and ammonia separators, and chemical cleaners were stored when the structure was utilized as a gashouse. Observing these symbols which are reminders of the previous function of the building, visitors of the museum perceive the duality of the space.

In addition, two theater halls were designed, serving the audience in two separate venues with 300 and 130 seats. One of these halls was made available for the use of Istanbul City Theaters (İleri, 2021). The library building, named after Afife Batur who made a great effort in the re-functioning of Gazhane, was previously a compressor building that was built during the third phase of the construction of the gashouse. This two-story reinforced concrete building, located nearby gasometers and water-gas facilities, was operated until the closure of the gashouse.

The carbureted water-gas facility building, and the building that is thought to have previously been used as a cleaning building for the furnace with the horizontal chamber, yet was afterward in use as a dining hall or with administrative and similar functions, have been designed as cafes, and they are run by Beltur.

The carbureted water-gas plant was built as a gas production plant during the second phase of the construction. The building, in which air gas was produced by spraying water on the coal, was deactivated in 1970 for certain technical reasons.

The two furnace buildings can be seen by the visitors during their tour between the buildings of the gashouse. One of the furnace buildings, being called machine-building, is a vertical furnace battery that was constructed of reinforced concrete in 1957. Although some parts of this building have been lost, the building has been largely preserved.

Built during the third construction phase of the gashouse, the other furnace

is the first vertical chamber furnace of the gashouse. This building too can be seen from the open areas, reminding the visitors of that they are inside a gashouse.

Moreover, the renovated water-cooling tower, which was built between 1952-1968, that is, in the third phase of the construction, can be seen from the open area and wandered by visitors. The terrace section, which Gazhane has due to its building typology, has been opened to visitors. From here, most of the buildings of the gashouse, as well as Hasanpaşa neighborhood can be partly seen.

One of the early-period structures of the gashouse, previously used as a warehouse and atelier, has been re-functionalized as a science center. This building, made of steel and masonry work construction, was previously in use both as a storage area and as an atelier for employees.

Because of its capaciousness, the gashouse has been re-designed in a way to be a mixed-function structure to make use of its buildings and open areas. This situation also corresponds to the third principle that Foucault defines as follows: " It is capable of juxtaposing in a single real place several spaces, several sites that are in themselves incompatible." (Foucault, 1984). This type of heterotopia, which Foucault exemplifies by theaters and cinemas, is found in the gashouse, as well. The use of this structure, which was originally designed as a gashouse, and is now in use as a cultural center and a museum with all its architectural indicators, epitomizes the juxtaposing of places that are indeed incompatible. Having accumulated and continuing to accumulate different experiences simultaneously, the structure brings together the epochs that are difficult to exist together, and creates an 'other space' in an existing space.

An archive documenting the efforts of the Gazhane Environmental Volunteers for many years to communize and make this structure that symbolizes a 100-year-old industrial activity a public space will also be permanently exhibited inside Gazhane. The records of the 26-year urban struggle and the documents of the restoration and re-functioning of the building are of significance in terms of social memory (İleri, 2021). Therefore, this exhibition will involve the audience in the process of perceiving the experiences simultaneously, taking them on a time travel about the structure they are visiting, and causing a break with traditional time.

Through the indicators in various parts of the structure, it is aimed to give information regarding the previous function of the building. By protecting the gas pipes and not hiding the original construction, the authentic function of the structure is emphasized to the visitors. The gashouse is home to buildings which Foucault cites to explain the principles of heterotopia, such as the buildings of museum and theater. However, the structure on its own also



Figure 6. Furnace structures, Author, 2021.



Figure 7. Climate Museum.



Figure 8. Pipes inside the Cafe, Author, 2021.

provides a break with traditional time. It mirrors an epoch merely by existing. For the very reasons, the building does not only correspond to one of the six principles in terms of its functions, yet possesses the characteristics explained in the other principles, as well. Foucault, for instance, indicates in the second principle that "each heterotopia has a precise and determined function within a society and the same heterotopia can, according to the synchrony of the culture in which it occurs, have one function or another" (Foucault, 1984). To evaluate the second principle through the social process, one should consider the technological conditions and needs of the epoch, the population of the district, and the sociological information about the inhabitants. Plenty of considerations including the centrality of the location, the value of the land, etc. come into play in decision-making about the structure. The facts that the new function of the gashouse could not be determined for several years, and that different proposals were on the agenda also provide insight into the management of the process.

Throughout history, city centers and industrial structures have transformed



Figure 9. Vertical furnace.



Figure 10. Indicators found in Structures, Author, 2021

due to global changes in the economy, politics, and technology. Just as the previous processes the structure underwent now allow us to witness the past; the decisions made today will also give an idea about our epoch in the future.

To illustrate, the sixth five-year progress plan, announced in 1989 and covering the years 1989 and 1994, was carried into effect to provide uninterrupted, cheap electricity to all parts of the country. Thereafter, electric energy was imported from Azerbaijan between 1993 and 1996 for the purpose of diversification of energy resources, efficient use of energy, and planned natural gas distribution (Özdemir, 2018). It is apparent that the gashouse, which was closed in 1993, came to be unfunctional due to the effect of this five-year progress plan.

Likewise, gasometers in the facility which were previously utilized for storage of air gas, liquefied gas, and the like, have been evaluated as a multi-purpose hall in the re-functioning project. This example also provides insight into the technological and social changes taking place during the process that has spanned more than a century.

The growth in the population of the district, particularly in the wake of the 1950s, that is, the peak period of rural-urban migration; increased the land values. Factors such as the need for housing, the increase in traffic, and the infrastructure requirements have resulted in unplanned housing in the district, thus bringing on various ideas regarding the gashouse. In his 'Space, Knowledge and Power', Foucault suggests that "The city is no longer perceived as a place of privilege, neither as an exception in a region of fields, forests, and roads. Instead, cities, in terms of the problems they pose and the forces they acquire, serve as models for the governmental reason exercised over the whole region" (Foucault, 1982). Thus, it is once again safe to state that the decisions made regarding Hasanpaşa Gazhane also reflect the government models.

Considering that heterotopias are structures that release unplanned energy from planned spaces; the heterotopic nature of the re-functionalized Gazhane finds expression in its longterm planning that changed in accord with government models. This process creates a mirror effect on the user by revealing the dichotomous energy of old and new in the structure.

5. Conclusion

We have examined the concept of heterotopia with the hermeneutic method, drawing on the principles defined by Foucault in his 'Of Other Spaces'. Examining the reflection of the concept on space through Hasanpaşa Gazhane structure, we have found that the user may encounter the 'other self' due to the mirror effect created by the 'Other Space' mentioned by Foucault.

We conclude that Hasanpaşa Gazhane can be defined as a 'heterotopic space' as the whole structure and especially its interior buildings disconnect the user from the traditional time and space, and create illusions in this way. The perception of the user, who witnesses the change and/or watches the change of the process via the documents, is present in traditional time, and meanwhile preserves the past in their memory. Inducing this situation, the spatial effect peculiar to heterotopic structures is found in the case of Hasanpaşa Gazhane.

Given the coexistence of experiences, the break with traditional time, time storage, and the changing functions along with social synchrony, we found that the re-functionalized gashouse epitomizes heterochronic and heterotopic spaces. The fourth principle being in the first place, the structure has characteristics corresponding to the second and third principles defined by Foucault. Thus, the structure, with its function and buildings, can make the user feel the effect of important periodic differences. Finally, the juxtaposing of the places that are incompatible in this structure and the strong presence of architectural elements of both the past and the present prove that the building can be considered heterotopic.

In the light of this study, different re-functioned structures will continue to be investigated in this context.

The way the interior corresponds to heterotopia and the triggering architectural elements will be studied to be determined.

In addition, the types of structures in which the principles of heterotopia, which were discussed in this study but could not find a place in the heterotopic analysis of Hasanpaşa Gazhanesi, corresponded, will continue to be investigated.

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Creating spaces for art: Long term impacts of street art in the urban context

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Abstract

Street art can be defined as any informal artistic performances or artworks practiced in the public spaces. Street art has the potential to transform the public spaces by contributing to or reducing the quality of these spaces. Through street art, in many cases, public spaces are transformed into places for entertainment, cultural activities, or areas of protests and expression of the feelings and ideas. The impacts of street art practices might be limited to one part of an open space or spread to a district or even to the entire city depending on its temporal dimension. This article aims to examine the relationship of street art and public space. In this context, the article overviews the concept of street art and demonstrates its positive, negative and temporal impacts on public space. This study uses a case study approach and evaluates the long term impacts of street art practices based on the analysis of three cases in the city of İzmir, Turkey. In İzmir cases it is found out that the street art practices transformed the public space in terms of uses, activities and built environment quality and had impacts on economic and social structure of the community. The findings of this study reveal that street art holds the potential of contributing to the city life through creating spaces for artistic activities and moreover of changing the meaning and identity of the public spaces and the settlements.

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Keywords

Street art, Urban art, Public space, Place identity, Transformation of public space.

1. Introduction

Street Art is not always called Street Art (Blanché, 2015). The concepts of Urban Art and Public Art are also used for similar artistic practices. But they are not identical. Among the three, urban art is the most inclusive one defined as "an umbrella term for any art in the style of street art, style writing or mural art" (Blanché, 2015, 38). Urban art involves any formal or informal artistic performances practiced in public spaces in the urban area.

Public art is perceived as any artistic public pieces located inside of a public space such as shopping malls, publically founded art museums and galleries or outdoor public spaces. (Moran & Byrne, 2018). Public art includes formal artistic expressions presented inside or outside the public spaces or spaces perceived as public spaces (third space). It has a wide range of practices from buildings or landmark towers to street sculptures. Public art projects gained importance by 1930s (Moran & Byrne, 2018). The art projects in the 1930s and 1940s such as 1935-1943 Federal Art Project (FAP) and 1933-1934 Public Works of Art Project (PWAP) in the United States were some outstanding examples aiming to support the artists financially following the Great Depression. (Gelber, 1979.) While its early attempts seemed as a struggle to support the unemployed artists, public art evolved in the form of artworks sited either temporarily or permanently in any media and public places (Moran & Byrne, 2018).

For street art, one of the early definition was used by Robbert Sommer in his book "Street Art" in 1975. He mostly used the term to refer murals and paintings and addressed the dimensions of legality and publicness (Sommer, 1975). A current definition is that street art represents informal artistic performances practiced mostly outdoor public spaces. According to the community responses it has the potential of being conceived as an illegal activity or in opposite an organized formal public activity.

Street art has a long history dates back to ancient ages. The practices of street art evolved based on the political and social changes in the world as well as technological innovations. Modern street art practices gained impetus



Figure 1. Conceptual Relations of Street Art, Public Art and Urban Art (Source: Author).

with pop art culture and have been performed in large number of types and styles using different tools and techniques. Currently, major types street art are graffiti including murals, reverse graffiti, stencil and sticker, posters, mosaic, 3D chalk art, wheat paste, collage, moss, rain works; guerilla gardening; 3D projection mapping; street installations including land art, sculptures, yarn bombing, everyday objects; and street performances including busking, pantomime, theatre, dancers, living statutes, jugglers, magicians, acrobats, clowns, flash mobbing (Kolcak, 2020).

Due to its interdependence with the street, street art becomes a site-specific conception. In describing the characteristics of street art, variations of site-specific terminology such as site-determined, site-oriented, site-referenced, site-conscious, site-responsive, and site-related are commonly referred by the artists and researchers (Kwon, 2002). However, street is not only a physical space. "The street is more than just a place for movement and circulation" (Lefebvre, 1970, 18). Conklin defines street art as "not just a spatial phenomenon; but as a complex social phenomenon that produces intense emotions for different people at different times and contexts" (Conklin, 2012, 5). Similarly, Moughtin (1992) states that street is not only a physical element in the city, it is also a social phenomenon, where the three-dimensional physical form which influencing the activities and indirectly social relations. The artworks in the context of street art use the street in various ways such as a canvas, a decor, a platform, a theme, an object, a participant or a social entity.

In the studies conducted since 2000s, street art has been associated with the concepts such as creative place-making, gentrification, tactical urbanization, revitalization or regeneration. Street art is defined as a tool of place-making in revitalization practices, a tool of tactical urbanism and pop-up urbanism (Doumpa & Broad, 2014), a tool of insurgent urbanism, a method of tourist attraction policy (Insch & Walters, 2017), a city branding policy (Sarah, 2011), or sometimes vandalism and crime (Ceccato & Wilhelmsson, 2012).

Though street art has a long history, the researches on the relationship of street art and public space is rather new. One of the initial efforts about street art and its relationship with urban space came from Conklin in her study "Street Art, Ideology and Public Space" in 2012. Emergence of new concepts such as tactical urbanism, creative place making have directly or indirectly contributed to the increase of the researches about street art. The researches questioning what street art is and its influences on urban space increased by the establishment of Urban Creativity Organization in Lisbon in 2014. Most of the researches focus on spatial, time wise and legality dimensions of street art (Blanché, 2015; Conklin, 2012). Some studies examine the connection between street art, space and place concern (Doumpa & Broad, 2014; Cox & Guaralda, 2016). There are very few studies on the impacts of street art in transformation of a space into a place (Kwon, 2002; Riggle, 2010).

This article aims to investigate the impacts of street art on public spaces and to reveal how street art changes the characteristics of the public spaces and their surroundings in terms of not only physical structure but also economic and social life of the district or the city. In this context, the article first examines the positive, negative and temporal impacts of street art and then focuses on the long term impacts on three cases with different characteristics and in different locations in İzmir.

2. The impacts of street art on public space

Street Art has many impacts on users of the space as street artists or audience of street art, and the city itself (Ursic, 2014). The impact of street art on public space can be in four forms;

1. Enhancing the Public Place \rightarrow Positive Impact

2. Transforming Unsuccessful Public Space into Public Place → Positive Impact

3. Transforming Lost Space into Public Place \rightarrow Positive Impact

4. Failure of Public Space \rightarrow Negative Impact

2.1. Positive and negative impacts

There is an increasing correlation between practices of street art and changes in socio-economic and urban dynamics (Forte & Paola, 2019). While reconstructing the built environment, street art can contribute to the "physical sustainability" or the "sustainability of the built environment". The contributions can be seen as change in land use, neighborhood, social structure, property values, economic activity, social mixing and participation. (Forte & Paola, 2019). Kwon describes the place of the art in public space with three paradigms. First, art placed outdoors to decorate or enrich the urban space like a sculpture; second, it creates public space; and third art is in the public interest. It embodies community messages, social issues and a stand of society with such practices as guerilla theatre, protest actions, dances, posters, etc. (Kwon, 2002) Similar to Kwon's arguments, Miles (1997) argues that art plays a role as decoration within a re-visioned field of urban design. Street art contributes to the revitalization and regeneration of urban space. Street art promotes the sense of place in public space. It also increases the physical, social and psychological accessibility, use and activity, sociability of the users, and enhances safety, comfort, mental and physical image of the space.

Beside its positive impacts, street art might cause a failure of the space due to its negative impacts on users, performance areas and its surroundings. In some cases, street art can cause physical damage such as noise and visual pollution or harms of contacting with chemicals. It may also cause negative psychological impacts by evoking sense of insecurity with over and amoral practices. Semi-illegal and semi-legal dimensions of street art are evoking the sense of crime, disorder, offensiveness, sense of scuzzy-ness on the users of the street (Conklin, 2012). While vandalism can cause physical deterioration, disorder, and motivates the fear of crime (Ceccato & Wilhelmsson, 2012), the damages created by vandalism give sense about the space that no one is in control. Vandalism also hide and reduce the significance of historical buildings and even cause the physical deterioration of the historical buildings (Dionisio & Ribeiro, 2013). Many cities spend an important budget for graffiti removal (Geason & Wilson, 1990). Another negative impact of street art practices is its influence on house prices (Ceccato & Wilhelmsson, 2012).

Either by increasing or decreasing the house prices it may lead to a change in the residents of the district. Successful street art practices can also indirectly affect public spaces negatively as it may cause gentrification. To overcome the negative impacts, many countries take precautions against the damages. The possibility of crime, fear of crime, vandalism, bad practices of street art and the cost of removal and preventing efforts force the cities to make legal arrangements to regulate street art practices.

2.2. Temporal impacts

Either negative or positive there is also a temporal dimension in street art's impacts. The temporal impacts of street art on public space can be categorized as short-term impacts and long-term impacts. Short-term is described as a period of time of less than one year while long-term is more than one year (Cambridge dictionary). The impacts on user perception on spatial quality can be seen in short term and the impacts related to the change in land use, buildings and urban layout, and social and economic structure can be seen in long-term.

The short-term impacts of street art differ according to street art types. For instance, busking performances temporarily affect the sensory experience of public space and connect with people on a humanistic level (Cox & Guaralda, 2016). A city square with musicians and entertainers make the space work as place (Whyte, 1980). The space becomes sociable, and attractive. Another street art type is the graffiti which not only attracts people's attentions on the walls, building facades, but also attracts the artists into the space and creates an opportunity for an interaction between artists and the audiences. People start to watch the performance and interact with each other which makes the public place more sociable. In some cases, the public space gains a reputation as "graffiti alley" and becomes a brand. The example of guerilla gardening provides the people's contact with nature, increases the biodiversity of the urban space and creates memorable place. While guerilla gardening brings visual and olfactive pleasure to the user of the space, another example, installation artwork surprises the users and create memorable places.

The long-term impacts of street art on public space can be observed in land use, social structure and participation, property values and economic activity of the area, building forms and layout. Street art contributes to city economy and regeneration of the city. Street art attracts the residents and tourist by highlighting an unknown space or renewing the image of the place (Cluzeau, 2017). A recent trend is that street art is promoted and exhibited in organized ways (Insch & Walters, 2017). To foster urban tourism various cities have been using street art by organizing street art walks, festivals and other activities. In urban tourism the role of the street art is conceived as "a vehicle to attract visitors to a city or neighborhood; a platform to bring vitality to smaller spaces within the city; a staged experience for visitors; a facet of residents place identity; and a vehicle for place-making for local businesses and residents" (Insch & Walters, 2017, 616).

In Penang (Malaysia) case, street art supported local industries such as local art, retails, restaurant, cafes, hotels, etc.; and led to increase new creative commercial developments in the city such as art galleries, museums, hotels, cafes and restaurants. Consequently, it had a role on Penang's local tourism and international tourism, as well (Fun, 2014). The example of Lennon Wall is similar to Penang city experience. Lennon Wall, located in Malá Strana (Czech Republic), is known as a traditional place for free expressions of Graffiti. When John Lennon was murdered, Czech activist people chosen the wall to express the idea of freedom and peace. Although the public authority tried to clean the wall, the graffiti practices repeated. After the decline of the regime the wall became a visiting space of tourists (Mc-Collum, & McCollum. n.d). Being a landmark, Lennon Wall contributes to development of pubs, cafes, hotels and other commercial and tourism facilities.

Liz Christy Community Garden in the Bowery Houston area in New York is a well-known example for transformation of lost space into a public place. In 1973 Liz Christy and her Green Guerrilla group transformed a derelict private lot into a garden without any permission. After a while it became a formal community garden provided the neighborhood with an open space rather than a built-up area. It allowed people to interact with the nature and with each other by sharing the activity of gardening. Then the garden was charged with \$ 1 a month by the City's office of Housing Preservation and Development. After a while, the plantation was varied and new residents of the garden such as turtles was added to garden. In 2002 the garden was transformed into a recreation area and an urban park (Loggins, 2007). Currently, the graffiti artists started to show themselves on the walls of the garden.

The impacts of street art on public space can be summarized as:

Short term impacts (associated mostly with the user perception on spatial quality):

- make the space multi-functional, attractive and interactive
- make the space perceivable and visible
- increase quality, vitality and accessibility for all groups
- provide easy orientation for the users
- surprise the users
- hold people longer time at the space
- create a landmark for the district or the city
- create human scale physical environment
- create sense of enjoyment and anticipation

• increase sensory experience of the space

• create memorable places

prevent sense of horror and crime

• provide contact with nature

• make the users volunteer to participate in the activities

• create shared activities for the community

• provide place for free expression

• attract additional artists into the space

• create an opportunity for an interaction between the artists and the audiences

• eliminate unused and uncared situation of the space

Long-term Impacts (associated mostly with the change in physical, social and economic structure):

- change in land use
- change in building facades and layout of the public space
- change in property values
- contribute to city economy, economic activity of the area
- support local industries
- led to increase new creative commercial developments
- foster urban tourism, attract visitors to a city or a district
- foster participation, communication and collaboration
- foster regeneration
- renew the image and identity of the place
- increase biodiversity

Negative Impacts (associated mostly with the user perception on spatial quality and the change in physical, social and economic structure):

- Causing physical damage to people
- · Causing physical damage to prac-
- tice area and surroundings
- Causing visual and audial pollution
- Causing bad psychological impacts on audiences or residents such as creating sense of crime, insecureness, disorder, offensiveness, scuzzy-ness and creating fear of crime
- Make house price down
- Brings social disorder
- Damaging personal rights
- Brings extra expenses for city economy such as cleaning costs of murals, repairing costs of surfaces of practice area

- Hidden and reduce significance of the historical buildings
- Causing residential displacement with gentrification process.

3. Three case studies in İzmir

The case research aims to evaluate the impacts of street art on public spaces and to reveal how street art changes the characteristics of the public spaces and their surroundings. The research focuses on the long term impacts of street art practices on three public spaces in İzmir. The research is conducted in 2019 and 2020. The cases are selected from different locations of the city at different scales including a corner in the public space, a neighborhood in the city center and a rural village in a coastal district. The cases are analyzed based on the review of the basic information about the case locations, site observations and interviews with key actors.

Case 1: Fahrettin Altay Metro Station, Üçkuyular

The first case shows how street art conceptually changes and finds a formal place in public space. It presents an example of an informal performance space transformed into a formal artistic activity area.

Fahrettin Altay Metro Station is located under Fahrettin Altay Square in Üçkuyular district of İzmir. The square is one of the major nodes and transportation hubs of the city. The station is adjacent to a terminal of buses which offers connections to the western coastal towns of the city including Urla, Çeşme, Seferihisar and Karaburun and to a ferry port which enables transportation between two sides of İzmir Bay. The station was opened in 2014, and soon became a place where the buskers often perform. Izmir Metropolitan Municipality noticed the potential of the buskers at the station in 2019 and decided to create an art corner. The municipality provided a fixed platform for buskers and registered the buskers. The platform was named as "Art exists in the Metro" (Metroda Sanat Var).

Before the municipality's intervention, users of the metro station mentioned that they felt uncomfortable with



Figure 2. Location of the cases in İzmir (Source: Adapted from Google Earth image).





the previous busking performances as they perceived the buskers use of the space untidy and uncontrolled. Sometimes the beggars tried to perform busking. Therefore, they felt that there would be theft or crime. After creating the platform some of the metro passengers mentioned that they enjoyed the performances, started listening and felt more comfortable and safe with the busking performances (The users of the Metro Station, personal communication, 2020).

The security staff stated that the number of the beggars decreased after the intervention. Buskers' response to the intervention was also positive as they thought that the intervention changed the common perception of the passengers about the buskers (T. Güzelsu, personal communication, 2020) Consequently, the number of audiences increased and indirectly it caused an increase in the tips for the buskers.

The fixed platform for buskers provided the sense of safety and pleasure to the users and provided the sense of place for the artist as an income opportunity. The positive and dynamic effect of street art was noticed by city administrations. Similar with the examples of Penang City Council (Malaysia) or the Municipality of Heerlen (Netherlands) that have been using street art as city policy, the Municipality of Izmir in 2019 published the Regulation for the Implementation of Street Arts in Izmir" (Izmir' de Sokak Sanatlarının Uygulanmasına Ilişkin Yönetmelik) to support and formalize street art practices.

Case 2: Umurbey Neighborhood, Konak

Umurbey Neighborhood, formerly known as Darağaç, is an example for the long-term impact of street art at district level. After almost a 30 years gap the district started to re-enter the urban memory with its new identity.

The neighborhood was vital and lively until 1985. Beside the houses there were 3 banks, 1 post office, 7 taverns, 8 barbers, 2 butchers, 4 greengrocers and 11 groceries in the neighborhood. The neighborhood was surrounded by industrial uses and important transportation connections of the city. Levanter, Greek and Turkish communities lived together in the neighborhood. In 1980s, the district started to lose its attractiveness as a residential area for younger generations. The young population of the neighborhood started to move to Bostanlı, Karşıyaka and Bayraklı districts. However, the property owners didn't attempt to rent or sell their abandoned houses. In the 1990s, the houses started to be used as work places such as car painting ateliers. However, most of the houses stayed abandoned and some of them became ruin. (H. Ateşçier, personal communication, 2020)

Today, the neighborhood hosts artist / artisan workshops and residents. The young artist groups seeking for alternative spaces for their art production discovered Umurbey Neighborhood and made the first art exhibition at street in 2016. After the exhibition, the distinctiveness and creativeness of the exhibition were noticed by other artist groups. Number of artists attending the exhibitions increased. The artists visited the neighborhood to practice their artistic activities such as painting, photography, sculpture, installation, video and performance, or to observe the neighborhood and even to live in. In 2017, the number of artists was 25, in 2018 was 30 and in 2019 was 35. The artworks attracted other artists into the neighborhood. Some artworks were noticed by other professions and they used the spaces as a decor of their works, an art object or a complementary part of art. The increasing demand to stay in the neighborhood also increased property values (C. Aksov, personal communication, 2020). On the other hand, as it is located just in the center of the city, the surroundings of the neighborhood started to be regenerated through high budget, high density investments in recent years.

One of the stimulating actors for those developmets in the neighborhood was the organization of "Darağaç", located in the area. The organization states its main goal as "to transform the neighborhood into a space where young artists can show their work and to create a common discourse;to encourage the artists to try new methods in the public sphere; ...to transform into a kind of experimental city institute;and to act as a reconciliation zone for the emerging artist and the public space". (Yavuzcezzar, 2019) The exhibitions have developed and matured with an atmosphere of intense dialogue and discussion between the artists, artisans and the residents of the neighborhood (C. Aksoy, personal communication, 2020). Yavuzcezzar describes the atmosphere of the neighborhood as

"Artists having muse from their

neighbors along with a cup of coffee when producing their own works of art, asking for what they need from the opposite window instead of over the phone, experiencing the feeling of being one while living together. Paintings on the walls, neighbors sitting on porches and children playing on streets; a neighborhood with the daily hustle and bustle of artists and craftsmen working, that warm feeling we recall from the past that always heals us. A place where daily chit-chat evolves into art events; where the residents are the artists, and artists are the spectators. Collective mind and effort that carry the spirit of the neighborhood, lend an ear to the voice of the artworks, listen to the people sharing their thoughts, experiences, and memories between the lines. Whatever surfaced to the daylight from the depths of your memory, whatever is on your mind, whatever taste that still lingers after reading this book - that's what Darağaç is." (Yavuzcezzar, 2019)

Currently, the neighborhood provides an open space where art created collectively through communication and collaboration of the artists with the residents. The streets, building facades and other public spaces are used to exhibit the artistic practices. All the neighborhood became an exhibition area ispired from the neighborhood life. To sum up, this case reveals how an abandoned neighborhood was discovered by artists and how the new face of the neighborhood attracted new users and residents to the district.

Case 3: Germiyan Village

The case of Germiyan Village is an outstanding example for long-term impact of street art on the settlement scale. In almost ten years the village transformed its identity from a typical rural character to a touristic village accommodating cultural activities.

Germiyan Village is located within the boundaries of Çeşme district. By 2019, the population of the village is 1290. The majority of the village population consists of the elderly. Young generation had left their village for education or business purposes. The change of the village character began with the individual voluntary attempts of a vil-



Figure 4. Installations of Darağaç Collective in Umurbey neighborhood (Source: Photographed by the Author in 2020).

lage resident, Nuran Erden. She started to draw traditional floral motifs on the walls of the village in 2009. She got reactions from the villagers in the beginning but then they enjoyed and asked her for painting their walls too.

"All the villagers accepted or wanted me to paint their walls. I got positive reactions from them. Only one person rejected and I responded as "the house might be yours but the wall is mine". I am increasing its value". (N., Erden, personal communication, 2020).

She conceived the walls of the village as a canvas for her artistic performances. She explained that the main purpose of her artworks was to attract visitors into the village and create an opportunity to make them spend time in the village, so that to contribute to the income of the residents. She aimed to revitalize the village by creating new employment opportunities and expected that the young population might not leave the village. Over time, she attracted attention of



Figure 5. Murals of N. Erden in Germiyan village (Source: Photographed by the Author in 2020).

many from different places and consequently the village started to become popular. In the following years the Municipality of Çeşme supported the village with sitting and lighting furniture, the streets were cleared and the visitors and residents of the village voluntarily painted the facades of the unused buildings all of which increased the quality of public spaces in the village. With the migration of new socio-economic groups, the population of village was increased, and the life of village vitalized (N., Erden, personal communication, 2020). Nuran Erden is still practicing her artworks in the village and attracts thousands of local and foreign tourists to the village every year.

Following the increasing popularity of the village, two important developments further changed the village life. One of them was the organization of the village festival. Germiyan Village Festival has been organized since 2015. During the festival competitions, exhibitions and workshops are held to present the traditional and natural products such as food, clothing and appliances. Also old pictures of the villagers and village life are presented. The second important development was that the village was assigned as the "First Slow Food Village of Turkey" in 2016. The villagers started to produce healthier food and other products which contributed to the village life and to the brand of the village.

The impact of new developments observed on land use, economic activities and property values. Village residents started to sell their home-made products and foods and wanted to open their homes for tourism. When the potential of the village is realized new restaurants and cafes are opened in the village. Besides the property values increased almost 6 times in ten years in between 2010 and 2020 (Emlakgazete, 2010; I. Kaya, personal communication, 2020). To sum up, street art was applied successfully to create a brand for the village and contribute to the village economy. Through its festivals, the village became further popular at national and international scales.

4. Discussion

In İzmir cases, street art practices transformed the public space in many ways, either positively or negatively. In Germiyan Village and Umurbey Neighborhood cases, the long-term impacts were in terms of adding new land uses, and new economic and cultural activities, supporting local industries, fostering local tourism, increasing property values, increasing built environment quality, changing building facades, fostering participation, communication and collaboration, regenerating the district and renewing the image and identity of the districts.

Compared the two, Fahrettin Altay Metro Station is a smaller place where less impacts are observed in the longterm. The informal practices resulted with a municipal attempt to form an art spot on one part of the station. With this attempt a new function is added and the space is changed slightly. As the station is a transition area short term impacts such as providing easy orientation for the users, surprising the users, creating sense of safety, place for free expression for the artists were dominant than the long-term impacts.

One questionable issue about street art is its regeneration impact. It has the potential of transforming the public spaces and the districts in which those spaces are located, not only in terms of physical appearance and special experience but also in terms of creating new economies and changing the social life. While upgrading the economy and the built environment quality, it also holds the risks of displacement of the residents due to increasing property values and losing the local characteristics. This might be the case in Germiyan Village and Umurbey Neighborhood. On the other hand, Umurbey Neighborhood is already under the pressure of gentrification because of the investments taking place in the surrounding areas and street art has an attitude against gentrification to conserve the neighborhood identity. However, because of new residents including artist groups and new artistic image of the district, it may again result with another kind of regeneration. In that sense street art may become a tool to foster regeneration and as well as a reaction against it.

Street art's contribution to the economy through tourism is also questionable. Attracting visitors to the district and creating new commercial and cultural areas contribute to the district to an extent. Tourism is a fragile sector affected from crisis easily. Tourism can contribute to the settlement if it supports local characteristics and identity rather than replacing them.

Another issue to be discussed is the status of the street art. Street art may be transformed from informal performances to formal practices thanks to its acceptance by the community and public authorities' attempts to support and benefit from its potential. This was

Table 1. Positive and negative long-term impacts of the case study areas (Source: Author).

Long-term Impacts	Case 1: Fahrettin Altay Metro Station, Üçkuyular	Case 2: Umurbey Neighborhood, Konak	Case 3: Germiyan Village
POSITIVE IMPACTS	-Foster participation, communication and collaboration -Renew the image and identity of the place	-Change in property values -Change in land use -Led to increase new creative commercial developments. -Change in building facades and layout of the public space -Contribute to city economy, economic activity of the area -Support local industries -Foster regeneration -Foster urban tourism, attract visitors to a city or a district -Foster participation, communication, and collaboration -Renew the image and identity of the place	-Change in property values -Change in land use -Led to increase new creative commercial developments. -Change in building facades and layout of the public space -Contribute to city economy, economic activity of the area -Support local industries -Foster urban tourism, attract visitors to activity or a district -Foster participation, communication and collaboration -Renew the image and identity of the place
NEGATIVE IMPACTS	-Causing sense of disorder -Causing sense of scuzzy-ness -Causing sense of insecureness -Creating fear of crime	-Causing physical damage to practice area and surroundings -Causing visual and audial pollution -Hidden and reduce significance of the historical buildings -Causing sense of disorder -Causing sense of scuzzy-ness -Causing sense of insecureness	-Causes residential displacement with gentrification process.

observed in all three cases in İzmir. However, street art stands against becoming formal. While regulated form of street art gives the users of the public spaces a sense of safety and makes the public spaces more comfortable for them, on the other hand being regulated and ruled, is not accepted by some of the street artists. The free space that provides inspiration, creativeness feeds the artist and society.

5. Conclusion

Studies that have been conducted so far show that street art has a potential to help to transform the public place. Street art directly or indirectly affect the physical space and the activities and users of the space. The effects differ according to temporal dimensions and scale of the public space. While in the short-term the impacts are mostly associated with the user perception on spatial quality, in the long-term, the impacts are related with the changes in physical, social and economic structure.

This article focuses on the long-term impacts of street art on public space. Long-term impacts can be summarized as changes in physical appearance, built environment quality, land use; changes in social life including the community activities and residents of the neighborhood or the district and users of the public place; and changes in economic structure including the economic activities and land values. These changes, in turn, may affect or change the image and identity of the public space and the districts that those spaces are located in. Moreover, street art itself may be transformed from informal practices to formal practices.

The long-term positive impacts of street art are generally observed with the case studies. However, considering the negative impacts of street art, the study reveals that street art has also potential to negatively change the physical, economic and social structure of a district or practice area in long-term. The negative impacts may result that the residents and local industries disturbed by street art leave the practice area or a district. In order to observe and detailed the long-term negative impacts of street art on public space, it is important to examine the changes of residents and land use in long-term periods especially for Case 2: Umurbey Neighborhood, Konak and Case 3: Germiyan Village.

As a being subjective phenomenon, the impacts of street art are correlated and shown with such local indicators as interviews, site-surveys, user perceptions, ... etc. The street art performances on some areas in Izmir and the impacts on public spaces are documented and achieved in the literature with this study. Moreover, it also creates a comparative database for the examination of the long-term impacts of street art on public space. On the other hand, considering negative impacts of street art on public space and conceptual transformation from informal practices to formal practices, the legal framework for street art practices in Izmir can be improved. Investigating the both positive and negative impacts of street art on change in land use and user profile, formation of special spaces designed for street art, formation of a settlement and its industries with street art, and the impacts of street art in architectural consideration such as urban acoustics, facade layout and solid void proportions may contribute to further researches.

Street art is both a cultural and a spatial phenomenon. Being a form of

expression and having fed by social events, street art gains a cultural dimension. It helps to create culture and spaces for culture. Street art, similar to art in general, is perceived differently by the individuals and the societies. Perceived either positively or negatively, street art can be an effective tool to create spaces for artistic performances and to provide creative working and living environment for the artists.

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Calculating the safe capacity of a stadium: Applying methods for assessment capacity on example of Konya City Stadium

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Abstract

Following the Hillsborough disaster (1989) which draws a very clear perspective on the football culture of the 20th century and the status of stadiums around the world, many of decisions about structure and organization were made for the stadiums in the Taylor Report published in England. To prevent recurrence of disasters, the stadium capacity issues were also emphasized among the decisions, and some sets of methods were developed to determine the final (official) capacity. In this paper, the criteria and the methods which are stated in national/ international regulations were gathered in a sequence. Then this sequence was implemented in a case study, Konya City Stadium which is one of the Turkey's EURO 2024 Candidate Bid Dossier stadiums. In the regulations, stadium capacity is classified as holding capacity, entry capacity, exit capacity and capacity of emergency exits. The final capacity is determined by whichever is the lowest. The local authorities determine that first three capacities by their subjective opinions. Because of that, mostly the capacity of emergency exits was emphasized in the study. This capacity, which is especially important for emergencies, was emphasized and the stadium was evaluated based on their capacities and evacuation times over all stands. As result, it was determined that the regulation criteria were not provided in some stands, however several suggestions were made based on the existing applications about how already built stadiums can be refurbished to follow the regulation.

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Crowd control, Emergency evacuation, Safe capacity, Stadium, Stadium regulations.

1. Introduction

Football tournaments bringing together people from different cultures brought forward conflicts, racism, social discrimination among groups, therewith hooliganism and violence in stadiums started to grow rapidly (Paramio et al., 2008). If the stadiums of 20th century are analyzed within the framework of their spatial characteristics and management policies, it is seen that most of them consist of unsafe standing terraces, inadequate entry and exit capacities, and weak barriers divide side by side sectors. It is also noticeable that there are barriers between sectors and pitch that higher human average height and that do not let passing in any emergency. In addition, unqualified/inadequate solutions in crowd control, which means that managing spectators to prevent all kinds of chaos, have caused more tragedies in stadiums (Darby et al., 2005). In this context, there were some tragic disasters that deeply affected the football world and were important in literature of stadiums.

After these disasters, global and local authorities have taken important steps to ensure safety and security in stadiums. As a matter of fact, with the Football Spectators Act published after release to the public of Taylor Report in 1989, certain regulations were introduced for national football leagues, tournaments, and stadiums in United Kingdom (TSO, 1989). In 1990, with the initiatives of FIFA and UEFA, an international control mechanism was established by determining the technical requirements that should be applied for the stadiums of the member associations. Providing the necessary conditions in stadiums has been accepted as the primary requirement of being a FIFA/UEFA member and organizing international events (FIFA, 1990).

To make a stadium safer, there are a great number of requirements that directly related to stadium capacity in various regulation books. Indeed, in usual or emergency situations, the most important factor in ensuring entries and exits in a stadium is to control capacity. Accordingly, the capacity categories are separated by some certain criteria in regulation books, and safe capacity is determined by choosing the most appropriate category (Kurumak, 2019). The lowest capacity value among the categories is accepted as the limit of final stadium capacity (DCMS, 2008).

In this paper, the demand-creating process of safety and security regulations used related stadium capacity explained in cause-link and a chronological perspective. It is obvious that though there are certain criteria to determine the final capacity of a stadium and how to provide it, there is not sufficient number of clarifications in practice. In addition, the local football authorities' regulations are differed partially by each other. Therefore, this article is set up to present the proper determining methodology of the final capacity by submit the sorted global and local regulations step-by-step and implement in a case study of Konya City Stadium. Afterwards, suggestions will be presented through practices in already built stadium samples on the refurbishment methods that can be made to increase the level of safe capacity and/or to ensure allowable evacuation times in stadiums.



Figure 1. The Gate 12, as the main scene of el monumental stadium disaster (Lisotto, 2018) (a,b), Stairway 13th of Ibrox Stadium before the disaster (The Sunday Post Newspaper, 1920) (c), Stairway 13th with damaged handrails and steps, after the disaster (Pink, 2018) (d), The collapsed wall in heysel stadium, 1985 (Shennan, 2017) (e), The people are crushed between pitch fences and overcrowd (Begley, 2017) (f).

2. Prominent stadium disasters

The stadium disasters that took place in various locations of the world have generally been seen in Europe, South America, and Africa. In fact, while the River Plate – Boca Juniors match held at Argentina El Monumental Stadium in 1968, people died by crushing and were injured in Gate 12 as result of the fire and panic. The stadium's standing terraces and narrow exits are the main causes of the disaster (Donuk & Şenduran, 2017) (Figure 1.a,b).

During the match (1971) of Celtic and Glasgow Rangers teams in Scotland Ibrox Stadium, the fans of Glasgow Rangers started to leave the stadium towards the last minutes of the match watched by 80.000 spectators, but with the 90th minute goal scored they turned back. On the stairway 13th (Figure 1.c,d), the fans who wanted to return to stands quickly and were exiting caused an overcrowd due to narrow stairway (Donuk & Şenduran, 2017).

In the European Champions Cup final match between Liverpool (England) and Juventus (Italy) teams at Heysel Stadium, which build in 1920, in Brussels on 29 May 1985, more than 60.000 tickets were sold for stadium with a capacity of 50.000 and no precaution was taken at ingress (Chisari, 2007).

Juventus fans who wanted to escape to protect themselves caused an overcrowd. Also, during this situation, a wall between stands collapsed and many people died. One of the most important reason of tragedy is that fences, which are between the stands and the pitch, were very high to let passing through (Figure 1.e) (Chisari, 2007).

The one of the most tragic stadium disasters in history took place during the FA Cup semi-final match between Liverpool and Nottingham Forest teams at Hillsborough Stadium (England) on April 15th, 1989. There had been currently 25.000 spectators in the 21.000-seat stadium just before the start of the match. The spectators who tried to move to stands caused an overcrowd in the stands and many people died by crushing because of the fences around the pitch (Figure 1.f) (Sawer, 2017).

During the league match between Kayserispor and Sivasspor Football Clubs at Kayseri Ataturk Stadia (1967) took place an important tragedy in Turkey football history. The fans breached the barriers of rival team stands and majority of the spectators started to go towards exit gates. But the exit gates' total width was not enough to receive. Therefore, the fans tried to breach barriers and fences and so many people stuck on them and overcrowd was not prevented (Çolak, 2018).

After the Hillsborough tragedy, P. M. Taylor, Lord Chief Justice of England, ran an inquiry report for causes of the disaster. Taylor stated in their report that the main reasons for the occurrence of the disaster in Hillsborough were the failure of officers control, insufficient turnstiles, and weakness of 'crush barriers'. In addition, although it was specified in the 'Safety of the Sports Ground Act' published by the Football License Authority in 1975, be in force in England and Wales, the regulation that stadiums must be 'all seated' is not provided until that day. Therefore, all stadiums must be providing that regulation until August 1994, according to report. Also, there are important statements in report about alcohol sales, crush barriers, fences around the pitch, turnstiles, and ticket prices (Taylor, 1989).

Taylor Report has had a profound impact on the safety standards provided in UK stadiums. So that fences around the pitches were removed and the stadiums used in high-level leagues were all seated. The new stadium locations have begun to move away from the big city centers, to decrease pedestrian/vehicle density (John et al., 2007). These decisions have been in force for all member associations with the 1998/1999 season with the changes made in UEFA directives (UEFA, 2014).

The first stadium built in full provided regulations in Taylor Report is Deva Stadium (1992), owned by Chester City Club, England. This was followed by The Den Stadium, built in 1993. It is the fact that the number of member football federations has reached 211 (FIFA, 2020), and these federations must comply with all directives set by FIFA, the safety and security regulations are applied in all stadia around the world. After this decision taken in general, the following refurbishments were made to meet the

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regulations in the existing stadiums operated by all member federations.

- All stands in the stadiums are 100% seated and the total capacity level has decreased accordingly.
- The grandstand is divided into certain sections, and the evacuation routes of all stands are also separated. Thus, the area covered by the routes (as in radial gangways) within the total area of the stand has increased (except for modern sophisticated applications).
- The quality of spectator viewing has become important in the regulations. Solutions with a single lower stand but far from the pitch in old stadiums have been replaced by stand solutions with more floors and a certain distance-height ratio (C Value-Sightline Elevation) to the pitch. Thus, vertical evacuation routes occupied more space in sequential stands. As a result, examples began to appear in which the total area (capacity) of the stand was waived.
- New standards in the regulations have encouraged stadiums to be privatized for a single event type. Thus, previously athletics etc. stadiums where side events are held are designed for only one sport. As a result, the required capacity level has also decreased.

3. Methodology of determining the safe capacity

This section is about the criteria and methodologies used in determining the final (official) stadium capacity, which are specified in several stadium regulations. Although these criteria and methods are in force for stadiums used for high-level international tournaments, most of that kind of stadiums' capacities are changed for local leagues. Indeed, some stadiums in Turkey, which are designed to participate in EURO 2016 and EURO 2024 tournaments, have variable capacity levels for local or international events. Capacity of Konya City Stadium (Figure 2.a), as case of the study, is 42.000 (approx.) for local and 38.529 (TFF, 2018) for international (EURO 2024) tournaments (Kurumak, 2019). The reasons of difference between that capacity levels are explained in subsections.



Figure 2. The west facade (a), a grandstand view of Konya City Stadium (b) and the divided sections of Konya City Stadium and the stands, which the research was applied on (Kurumak, 2019) (c).

Minimum stadium capacities determined for UEFA EURO 2024 tournament are included and the criteria used for the tournament are taken as basis. Thus, existing capacity assessments was conducted over a sample of Konya City Stadium in Turkey. The stadium is nearly 9 km. away from the city center and opened in 2014 on 250.000 m2 actively used area (BKA, 2014; Öztaşkın, 2015). Moreover, the stadium consists of 8 stand sections. Sections are divided as four upper and four lower tiers (Figure 2.b,c). There are four evacuation halls at all corners of the grandstand. The stadium has also various amount of vomitories, which number of five to six for different stands, that between radial gangways and concourses.

The minimum capacity requirements for each tournament are different. According to EURO 2024 tournament requirements, there are at least 3 stadiums of minimum 50.000 capacity (One of them must have min. 60.000), at least 3 stadiums of minimum 40.000 capacity, at least 4 stadiums of minimum 30.000 capacity in candidate countries (UEFA, 2017). On the other hand, stadium capacities should be at a level that does not weaken the safety and security requirements provided (FIFA, 2018). Thus, the following criteria should be applied when determining the max. capacity that can be provided in a stadium where adequate safety measures are taken (FIFA, 2018; DCMS 2008).

3.1. Holding capacity (A)

Holding capacity is determined by the number of seats available under min. safety conditions. A two-step method is applied to calculate the holding capacity. In the first stage, the seats that should not be used according to the safety measures are removed from the final capacity. These seats are partially or completely obstructed with such as structural components, billboards, fences etc.; damaged, or later added; at the points that should be kept clear for emergency evacuation plans and security staff's working areas; that do not provide the standards in seats, stand rows etc. dimensions (FIFA, 2018).

In the second stage, the factors P (physical condition) and S (safety management), which are the indicators of the structural and operational layouts of a stadium, respectively, are determined. These factors, whose controls and calculations are in responsibility of the local football authorities, are determined by the experts at subjective perspective. Each factor should be given a numerical value, which quantified 0.0 to 1.0, and holding capacity of the seated are can thus be calculated as follows (DCMS, 2008) (formula 1).

Holding capacity (A)=the number of useable seats x (P)or(S), whichever is lower (1)

The following criteria are taken into consideration in calculating the P factor. The P factor value depends on criteria as providing of rows depth and riser height standards, avoiding of usage weak stadium cover or grandstand structure components, and managing strategies towards restricted spectator viewing (DCMS, 2008).

The following criteria are taken into consideration in calculating the S factor. The S factor value depends on criteria as; the official ticket sales should be only for allowed seats according to P factor, the layout of stands and rows should be clear to follow for spectators, the stands should be cleaned/kept clean before each event, the stewarding should be deployed in every necessary point of stands (DCMS, 2008).

3.2. Entry (B) and exit capacity (C)

Entry capacity is calculated with the number of person who can pass through the available turnstiles and/or other controlled ingress points in one hour for usual situations. The factors that determine the entry capacity are number of available turnstiles and other entry points. Exit capacity is determined by the number of persons who can exit a stadium safely in the usual time. The factors that affect the exit capacity are number and size of exit gates (DSMS, 2008; FIFA, 2018).

3.3. Capacity of emergency exits (D)

Emergency exits capacity is calculated based on the number of persons who can reach safety zone by passing the evacuation routes safely, smoothly, and unimpeded within a time in a case of emergency. The time limits determined by FIFA (10 min.) and UEFA (8 min.) for member federations, it is not allowed to exceed (FIFA, 2011; UEFA, 2017).

If stadium design allows for exits to pitch from the stands in emergency situations, the pitch is accepted as a safety zone. However, different strategies should be developed to make more quickly the playing area exits to out of the stadium (FIFA, 2018).

As it is specified in Building and Fire Safety Regulations of Turkey, in Article 33 (1), Annex-5/A and Annex-5/B 'number and width of evacuation routes', the route elements min. total widths are calculated by the formula 2 as follows (MPWS, 2007);

$$\Sigma_{\rm w}(m) = (Gxw)/P \qquad (2)$$

Figures in formula refer to; Σ_w :min. total width; G:capacity of sample section; w:0,5m. (shoulder width, regulation constant); P:regulation's constant (G/minutesXm.). Stairs, vomitories, doors and any part of concourses widths are minimum 110 cm. at restrictive points in a stadium, even if these elements are also used in usual situations, according to Article 33(1) (MPWS, 2007). Minimum widths are specified as 120 cm. in European standards (Nixdorf, 2007; DCMS, 2008).

TSE's standards, which are in force, (TS 7394 and TS 7395) have not any information about relevant regulations. However, the number limits of people who can pass through the evacuation routes in per unit width (1 m.) and per unit time (1 min.) are given as follows;

- According to BS EN 13200-1:2003 and DIN 13200-1:2004, 66 people/ min.Xm. for staircases, 82 people/min. Xm. for vomitories and concourses (Nixdorf, 2007; DCMS, 2008).
- According to Turkish Building and Fire Safety Regulations (Annex-5/B), 60 people/min.Xm. for staircases, 100 people/min.Xm. for vomitories and concourses (MPWS, 2007).

To calculate the evacuation times of a stadium, the number of person (k) that can pass in one second through the minimum width of evacuation routes (1.1 m.) according to the regulation must know in first step. It is calculated by the following formula 3 (MPWS, 2007).

$$k=(Px1.1)/(60((sec.)/(1min.)))$$
 (3)

Afterwards the minimum evacuation time is based on the number of spectators of all stadia or a section and on total route width is calculated by the following formula 4 (MPWS, 2007).

$$t(sec.) = G/(\Sigma_w xk)$$
(4)

There are some important factors in usage of calculations are above (DSMS, 2008);

- If there is more than one route that spectators can use in sample sector, the shortest one should be regarded in calculation.
- If there are changes in one of routes width, the evacuation time should be calculated based on most restrictive element (stairs, vomitories or whichever) of route.
- The longest evacuation time within the separate sectors is accepted as the total evacuation time of a stadium.

After the A, B, C and D capacities are determined separately, the lowest capacity value is accepted as the safe capacity of a stadium (DCMS, 2008; FIFA, 2018). **Table 1.** The official capacity of Konya City Stadium and its sections according to A, B and C Factors.

Stand	Official Capacity						
Lower West		3797					
Lower East		4269					
Lower South		3754					
Lower North		3748					
Upper West	3153	1544 VIP and					
	Spectator	Iotal	Press				
Upper East		5841	A				
Upper South		7307					
Upper North	5116						
Total	38.529						



Figure 3. The elements of all evacuation routes in the Konya City Stadium, which also in similarly planned stadiums.

The local football authorities are responsible for accepting the maximum capacity value of stadiums to be used for international tournaments according to the criteria given above. The final capacities are certificated by FIFA and these stadiums cannot be used over official capacities in high-level FIFA/UEFA events. Final capacities are updated every 2 years and in case of changes are made in structural or operational layouts of a stadium (FIFA, 2018).

4. Findings of the case study

The capacity of Konya City Stadium officially determined by UEFA is 38.529 in total. Therefore, the stadium is enabled to use for EURO 2024 tournaments (min. 30.000 capacity is required). The official capacities of the stands are illustrated in Table 1. While calculating these capacity values determined by UEFA, holding, entry and exit types were considered. However, these values are determined subjectively by the local authorities over the P and S factors, UEFA delegate report was used for this capacity data. However, the most important factor in determining



Figure 4. The sample of radial gangways and inner evacuation gates in the lower stands (a), Pitch evacuation halls (b), Vomitories (c), Stand staircases (d,e), and Outer evacuation gates (f).

the final capacity is calculation of emergency exits, which is only determined by objective methods in capacity criteria, should not be ignored. So, emergency is the main focused point of methodology in case study. To increase the accuracy of the study, the strictest number limits of people who can pass through the evacuation routes in per unit width (1 m.) and per unit time (1 min.) in the regulations were used.

Konya City Stadium has two evacuation routes for its each upper stand and one evacuation route for its each lower stand in terms of spatial characteristics. Only in the upper west stand, there are many detached sections (VIP, press etc.) due to diversity of the spectators' profile, and an additional route named UER2 (Upper Evacuation Route) is formed. All evacuation, and their elements, which from seats to safety zones, are located as follows. The elements of stadium evacuation routes, which radial-lateral gangways, vomitories, gates, halls etc., on a sample figure 3 within a stand section drawing. In lower stands;

• First lower evacuation route (LER (Lower Evacuation Route) 1) consists of; lower radial gangways (1), inner evacuation gates (2) (Figure 4.a), pitch (3) and pitch evacuation

halls (4) (Figure 4.b).

• Second lower evacuation route (LER2) consists of; lower radial gangways (1) (Figure 4.e), lower vomitories (5) (Figure 4.c), lower stand staircases (6) (Figure 4.d) and outer evacuation gates (7) (Figure 4.f).

The minimum width of these halls, which can be used two of them for lower west stands at the same time, is 7,1 meters each. The minimum width of lower east stands is 5,0 meters each. The all-radial gangways (1) widths are 1,2 meters, that provided the minimum width requirement (1.1 m.). On the other hand, inner evacuation gates' (2) width are also 1,2 meters, lower west-east stands have 6 of inner evacuation gates and lower radial gangways, each. However, the north-south stands have only 5 of them. The all vomitories (5) of lower west and lower east stands connect the radial gangways with stand concourses. But in lower north and lower south stands have got any vomitory. The last rows are tied up directly with the hall of stand. Thus, the measures of the vomitories were not included the general calculations. The number of vomitory is the same with radial gangways for remainder stands. Their width is 2,0 meters each for the lower stands and 2,5 meters each for the upper stands. Stand staircases (6) and outer evacuation gates (7) are separated within use for lower and upper stands, different amount and sizes is applied on them. Therefore, all stands in case study are analyzed separately. So, in upper stands;

- First upper evacuation route (UER (Upper Evacuation Route) 1) consists of; upper radial gangways (1), upper vomitories (5) (Figure 5.a), upper stand staircases (6) (Figure 5.b) and outer evacuation gates (7).
- The second evacuation route of the upper west stand (UER2) consists of; upper radial gangways (1), upper vomitories (5), upper hall doors (8), upper stand staircases (6) and outer evacuation gates (7).

The total width of evacuation routes (Σ_w) is 54,2 meters in lower west stand, the requirement criteria is provided with 54,2 meters is above the minimum regulation limits, determined by calculations as follows;

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 $\Sigma_w(m) = (Gxw)/P \Rightarrow \Sigma_w(m) = (3797x0,5)/66$ ⇒ (3797x0,5)/66=28,76 m.

Maximum number of persons that is able to use the evacuation route elements in all stands because the class (66 people/min.Xm.) of the most restrictive element is the same, which is specified as 1.1 m. unit width, in one second is calculated with equation as follows;

 $k=(Px1.1)/(60(sec./(1min.))) \Rightarrow$ $k=(66x1.1)/(60) \Rightarrow (66x1.1)/(60)=1,21$

The most restrictive elements in LER1 of lower west stand are lower radial gangways (1) and inner evacuation gates (2) with 7,2 meters total width. Also, one of the other elements is pitch evacuation halls (4) with 14,2 meters total width. Thus, 7,2 meters value is accepted as the lowest width on LER1. There are two stairs with 1,2 meters each width in lower west stand. These lower stand staircases (6) are the most restrictive elements on LER2 with 2,4 meters total width. So, 9,6 meters value (7,2+2,4) is accepted as the lowest width on all lower west stand (Table 2). The total evacuation time was determined by the equation as below. According to the equation results, total evacuation time of the lower west stand is 5,44 minutes and it is provided the regulation criteria by under 8 minutes. Thus, the official capacity of the stand could be accepted as the final capacity.

t(sec.)=G/($\Sigma_w xk$) ⇒ t=3797/ (9,6x1,21) ⇒ 3797/(9,6x1,21)=326,87 sec.=5,44 min.

The total width of evacuation routes (Σ_w) is 59,6 meters in lower east stand, the requirement criteria is provided with 59,6 meters is above the minimum regulation limits, determined by calculations as follows;

 $\Sigma_{w}(m) = (G \times w) / P \Rightarrow \Sigma_{w}(m)$ =(4269x0,5)/66 \Rightarrow (4269x0,5)/66=32,34 m.

The most restrictive elements in LER1 of lower east stand are lower radial gangways (1) and inner evacuation gates (2) with 7,2 meters total width. Also, one of the other elements is pitch evacuation halls (4) with 10,0



Figure 5. The Sample of Vomitories, Radial Gangways (a), and Stand Staircases (b) in Upper Stands.

Table 2. The second s	ie Information	of LER1 and	LER2 in	lower stands.
	2	2		

	STAND									
		LOWER WEST								
LER1	Elements of Evacuation Route	Unit Width (m)	Amount	Total Width (m) Σ _w	Unit's Lowest Width (m)	The Lowest Width on Entire Route (m)	The Most Restrictive Element and Its Code	The (P) Value of Restrictive Element		
	Lower Radial Gangways	1,2	6	7,2	7,2		Lower Radial Gangways (1)	66 pers./min. x m.		
	Inner Evacuation Gates (2)	1,2	6	7,2	7,2	7.2	and Inner			
	Pitch (3)	-	1	-	-	Í Í	Gates			
	Pitch Evacuation Halls (4)	7,1	2	14,2	14,2		(2)			
2	Lower Radial Gangways (1)	1,2	6	7,2	7,2			66		
5	Lower Vomitories (5)	2,0	6	12,0	12,0	2,4	Staircases (5)	pers./min.		
-	Lower Stand Staircases (6)	1,2	2	2,4	2,4			<i>x</i> m.		
	Outer Evacuation Gates (7)	2,0	2	4,0	4,0					
				54,2	LOW	9,6				
	Lower Badial Gangways				LOWE	ER EAST	Lower Radial	66 pers./min. <i>x</i> m.		
-	(1)	1,2	6	7,2	7,2	7,2	Gangways (1) and Inner Evacuation Gates			
6	Inner Evacuation Gates (2)	1,2	6	7,2	7,2					
5	Pitch (3)	-	1		-					
	Pitch Evacuation Halls (4)	5,0	2	10,0	10,0		(2)			
LER2	Lower Radial Gangways (1)	1,2	6	7,2	7,2		Lower Radial Gangways (1)	66		
	Lower Vomitories (5)	2,0	6	12,0	12,0	7,2		pers./min.		
	Lower Stand Staircases (6)	4,0	2	8,0	8,0	-		xm.		
_	TOTAL	2,0	4	50.6	0,0	14.4				
	STAND			55,0	LOWE	B SOUTH				
	Lower Radial Gangways		-		20112	<u>300111</u>	Lower Radial Gangways (1)	66		
	(1)	1,2	5	6,0	6,0					
11	Inner Evacuation Gates (2)	1,2	5	6,0	6,0	6,0	Evacuation	pers./min.		
-	Pitch (3)	-	1	-	-		Gates	xm.		
_	Pitch Evacuation Halls (4)	5,0	2	10,0	10,0		(2)			
엁	Lower Hadiai Gangways (1)	1,2	5	6,0	6,0	_	Lower Badial	66		
Ξį	Lower Vomitories (5)	0	0	0	7.0	6,0	Gangways (1)	pers./min.		
- 1	Outer Evacuation Gates (7)	2.0	4	7,0	7,0	1		×		
_	TOTAL	2,0	<u> </u>	43.0	0,0	12.0				
STAND				10,0	LOWE	R NORTH				
	Lower Radial Gangways	10	-	6.0	<u> </u>		Lower Radial			
- -	(1)	1,2	5	6,0	6,0		Gangways (1)	66		
町	Inner Evacuation Gates (2)	1,2	5	6,0	6,0	6,0	Evacuation	pers./min.		
-	Pitch (3)	-	1	-	-	-	Gates	<i>x</i> m.		
_	Pitch Evacuation Halls (4)	5,0	2	10,0	10,0		(2)			
멅	Lower Hadiai Gangways (1)	1,2	5	6,0	6,0		Lower Radial	66		
Ξ	Lower Vomitories (5)	2.5	0	70	7.0	6,0	Gangways (1)) pers./min.		
3	Outer Evacuation Gates (7)	2.0	4	7,0	7,0	1		× m.		
	cuto. Efactuation Gales (1)	2,0		0,0	0,0	10.0				

meters total width. Thus, 7,2 meters value is accepted as the lowest width on LER1. The lower radial gangways (1) are the most restrictive elements on LER2 with 7,2 meters total width. There are 4,0 meters each wide two stairs in lower east stand. So, 14,4 meters value (7,2+7,2) is accepted as the lowest width on all lower east stand (Table 2). The total evacuation time was determined by the equation as below. According to the equation results, total evacuation time of the lower west stand is 4,08 minutes and it is provided the regulation criteria by under 8 minutes. Thus, the official capacity of the stand could be accepted as the final capacity.

t(sec.)=G/(Σ_w xk)⇒t=4269/(14,4x1,21) ⇒4269/(14,4x1,21)=245,00sec.=4,08 min.

_									
	STAND	UPPER WEST							
	Elements of Evacuation					The Lowest	The Most	The (P)	
	Boute	Unit		Total	Unit's	Width on	Restrictive	Value of	
	noute	Width	Amount	Width	Lowest	Entire Route	Element and Its	Restrictive	
Ξ		(m)		(m) Σ _w	Width (m)	(m)	Code	Element	
ш	Upper Radial Gangways								
∍	(1)	1,2	4	4,8	4,8		University Desident	66	
	(1)	2.5	2	5.0	5.0	10	Opper Hadiai	pore /min	
		2,5		5,0	5,0	4,0	Galigways (1)	pers./min.	
	Opper Stand Staircases (6)	4,0	2	8,0	8,0		(1)	x m.	
	Outer Evacuation Gates (7)	2,0	4	8,0	8,0				
	TOTAL			25,8		4,8			
	STAND			UPF	PER <u>WEST (V</u>	IP and Press A	reas)		
	Upper Radial Gangways	12	8	9.6	9.6				
	(1)	1,2	0	5,0	5,0				
2	Upper Vomitories (5)	2,5	4	10,0	10,0		Upper Stand	66	
ų.	Upper Hall Doors (8)	2,0	3	6,0	6,0	5,4	Staircases	pers./min.	
5	Upper Stand Staircases (6)	1,8	3	5,4	5,4	-	(6)	x m.	
	Outer Evacuation Gates (7)	2,0	3	6,0	6,0	-			
	TOTAL			37.0		5.4			
	STAND								
	Jinner Dadiel Commune		1		UFFL	1 <u>300m</u>	1	1	
	Opper Radial Gangways	1,2	10	12	12	7,0			
	(1)						Upper Stand	66	
뜐	Upper Vomitories (5)	2,5	5	12,5	12,5		Staircases	pers /min	
Ë	Upper Stand Staircases (6)	3.5	2	7.0	7.0		(6)	xm	
		0,0	-	,,0	.,,•				
	Outer Evacuation Gates (7)	2,0	2	8,0	8,0				
	TOTAL			39,5		7,0			
	STAND				UPPEI	R <u>NORTH</u>			
	Upper Radial Gangways	10	10	10	10				
	(1)	1,2	10	12	12				
Ξ	Upper Vomitories (5)	2,5	5	12,5	12,5	-	Upper Stand	66	
Щ.						7,0	Staircases	pers./min.	
2	Upper Stand Staircases (6)	3,5	2	7,0	7,0		(6)	<i>x</i> m.	
	Outer Evacuation Gates (7)	2,0	4	8,0	8,0	-			
	TOTAL			39.5		7,0			
STAND					UPPE	R EAST	1		
	Upper Badial Gangways	orren <u>EAST</u>				1			
	(1)	1,2	12	14,4	14,4			66	
튪	(') Upper Vomitories (5)	2.5	6	15.0	15.0	7.0	Upper Stand	nore /min	
Ē	Upper Volintories (5)	2,0	0	15,0	7.0	7,0	Staircases (6)	pers./mln.	
-	opper Stand Staircases (6)	3,5	2	7,0	7,0		(0)	xm.	
	Outer Evacuation Gates (7)	2,0	4	8,0	8,0				

44,4

TOTAL

Table 3. The information of UER1 and UER2 in upper stands.

The total widths of evacuation routes (Σ_w) in lower south and lower west stands are 43,0 meters, the requirement criteria are provided in both of stands with 43,0 meters is above the minimum regulation limits, determined by calculations as follows;

For the lower south stand:

 $\Sigma_w(m) = (Gxw)/P \Rightarrow \Sigma_w(m) = (3754x0,5)/66$ $\Rightarrow (3754x0,5)/66 = 28,44 \text{ m}.$

For the lower north stand:

 $\Sigma_w(m)=(Gxw)/P \Rightarrow \Sigma_w(m)=(3748x0,5)/66$ $\Rightarrow(3748x0,5)/66=28,40 \text{ m}.$

The most restrictive elements in LER1 of these stands are lower radial gangways (1) and inner evacuation gates (2) with 6,0 meters total width. Also, one of the other elements is pitch evacuation halls (4) with 10,0 meters total width. Thus, 6,0 meters value is accepted as the lowest width on LER1. The lower radial gangways (1) are the most restrictive elements on LER2 with 6,0 meters total width. There are 3,5 meters each wide two stairs in both

of stands. So, 12,0 (6,0+6,0) meters value is accepted as the lowest width for lower south and lower north stands separately (Table 2). The total evacuation time was determined by the equation as below. According to the equation results, total evacuation times of the lower south and the lower north stands are 4,30 minutes and that is provided the regulation criteria by under 8 minutes. Thus, the official capacity of the stands could be accepted as the final capacity.

For the lower south stand:

t(sec.)=G/(Σ_w xk)⇒t=3754/(12,0x1,21) ⇒3754/(12,0x1,21)=258,54 sec.=4,30 min.

For the lower north stand:

t(sec.)=G/($\Sigma_w xk$)⇒t=3748/(12,0x1,21) ⇒3748/(12,0x1,21)=258,13 sec.=4,30 min.

There are two separated evacuation routes (and sections) in the upper west stand. One of them (UER2) is used by VIP and press members, the other one (UER1) is used by ticketed spectators. The capacity value also varies in different sections. The total evacuation routes' width (Σ_w) for ticketed spectators is 25,8 meters and 37,0 meters for VIP and press members in the upper west stand, the requirement criteria is provided with both evacuation routes as are above the minimum regulation limits, determined by calculations as follows;

UER1: $\Sigma_w(m)=(Gxw)/P \Rightarrow \Sigma_w(m) = (3153x0,5)/66 \Rightarrow (3153x0,5)/66 = 23,89 m.$

UER2: $\Sigma_w(m) = (Gxw)/P \Rightarrow \Sigma_w(m) = (1544x0,5)/66 \Rightarrow (1544x0,5)/66 = 11,70 m.$

The most restrictive elements in UER1 of upper west stand are upper radial gangways (1) with 4,8 meters total width. Also, the other elements are upper vomitories (5) with 5,0 meters, outer evacuation gates (7) and upper stand staircases (6) with 8,0 meters total width. Thus, 4,8 meters value is accepted as the lowest width on UER1 for upper west stand (Table 3). The total evacuation time for UER1 was determined by the equation as below;

t(sec.)=G/($\Sigma_w xk$ ⇒ t=3153/(4,8x1,21) ⇒ 3153/(4,8x1,21)=542,87 sec.=9,05 min.

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Total evacuation time of the upper west stand for UER1 is 9,05 minutes and it is not provided the regulation criteria by above 8 minutes. The official capacity of the stand could not be accepted as the final capacity. So, the new final capacity, which should be applied, is calculated with formula as follows;

Gmax=480(8 min.)x4,8x1,21 = Gmax=2787 seats instead of 3153

On the other hand, the most restrictive elements in UER2 for the upper west stand are upper stand staircases (6) with 5,4 meters total width (Table 3.). Also, the other elements are upper radial gangways (1) with 9,6 meters, upper vomitories (5) with 10,0 meters, upper hall doors (8) with 6,0 meters and outer evacuation gates (7) with 6,0 meters total width. The total evacuation time for UER2 was determined by the equation as below;

t(sec.)=G/($\Sigma_w xk$) ⇒ t=1544/(5,4x1,21) ⇒ 1544/(5,4x1,21)=236,30 sec.=3,94 min.

The total width of evacuation routes (Σ_w) is 39,5 meters in the upper south and the upper north stands, the requirement criteria is not provided in the upper south stand, because 39,5 meters is under the minimum regulation limits, determined by calculations as follows;

For the upper south stand:

 $\Sigma_{w}(m) = (Gxw)/P \Rightarrow \Sigma_{w}(m) = (7307x0,5)/66 = 55,35 \text{ m.}$

For the upper north stand:

 $\Sigma_{\rm w}({\rm m}) = ({\rm Gxw})/{\rm P}$ $\Sigma_{\rm w}({\rm m}) = (5116{\rm x}0,5)/66 = 38,75 {\rm m}.$

The most restrictive elements in UER1 of these stands are upper stand staircases (6) with 7,0 meters total width. Also, the other elements are upper radial gangways (6) with 12,0 meters and outer evacuation gates (7) with 8,0 meters total width. In addition, there are only 5 radial gangways in either stands. But since the vomitories are in the middle of the radial gangways, there is a degradation in the evacuation route for the spectators at the upper and lower rows of the stands. 7,0 meters value is accepted as the lowest width on UER1 for all upper south and

Table 4. The emergency exits capacities and related values of the Konya City Stadium Stands.

Stands Elements	Lower West	Lower East	Lower South	Lower North	Upper West	Upper West (VIP)	Upper East	Upper South	Upper North
Essential Minimum Total Width (Σ_w) (m)	28,7	32,3	28,4	28,4	23,8	11,7	44,2	55,3	38,7
Total Width of Evacuation Routes (m)	54,2	59,6	43,0	43,0	25,8	37,0	34,2	39,5	39,5
The Lowest Width of Entire Route (m)	9,6	14,4	12,0	12,0	4,8	5,4	7,0	7,0	7,0
Total Evacuation Time (min.)	5,44	4,08	4,30	4,30	9,05	3,94	11,49	14,38	10,07
Regulation Criteria (8 min.) is	Provided	Provided	Provided	Provided	Not Provided	Provided	Not Provided	Not Provided	Not Provided
Regulated Capacity		-	-	-	2787	-	4065	4065	4065
Capacity Gap	-	-	-	-	366	-	1776	3242	1051

upper north stands (Table 3). The total evacuation time was determined by the equation as below;

For the upper south stand:

t (sec.) = G / ($\Sigma_w x k$) ⇒ t = 7 3 0 7 / (7,0x1,21)=862,69 sec.=14,38 min.

For the upper north stand:

 $t(sec.) = G/(\Sigma_w x k) \Rightarrow t = 5116/(7,0x1,21)=604,01 sec.=10,07 min.$

Total evacuation times of the upper south and upper north stands are respectively 14,38 and 10,07 minutes. These are not provided the regulation criteria by above 8 minutes. The official capacity of the stands could not be accepted as the final capacity. So, the new final capacities, which should be applied, is calculated with formula as follows;

Gmax=480(8min.)x7,0x1,21 \Rightarrow Gmax=4065 seats instead of 7307 and 5116

The total width of evacuation routes (Σ_w) is 34,2 meters in upper east stand, the requirement criteria is not provided with 44,4 meters is just above the minimum regulation limits, determined by calculations as follows;

 $\Sigma_w(m) = (Gxw)/P \Rightarrow \Sigma_w(m) = (5841x-0,5)/66 \Rightarrow (5841x0,5)/66 = 44,25 m.$

The most restrictive elements in UER1 of upper east stand are upper

stand staircases (6) with 7,0 meters total width. Also, the other elements are outer evacuation gates (7) with 8,0 meters and upper radial gangways (1) with 14,4 meters (7,2 m. for upper rows; 7,2 m. for lower rows) total width. Thus, 7,0 meters value is accepted as the lowest width on UER1 and all upper east stand (Table 3). The total evacuation time was determined by the equation as below;

 $t(\text{sec.})=G/(\Sigma_w xk) \Rightarrow t=5841(7,0x1,21) = 689,61 \text{ sec.}=11,49 \text{ min.}$

Total evacuation time of the upper east stand is 11,49 minutes and it is not provided the regulation criteria by above 8 minutes. The official capacity of the stand could not be accepted as the final capacity. So, the new final capacity, which should be applied, is calculated with formula as follows;

Gmax= 480 (8min.) x7,0x1,21⇒Gmax = 4065 seats instead of 5841

5. Conclusion and suggestions

The emergency exits capacities and evacuation times of Konya City Stadium are analyzed. These are illustrated within certain criteria in Table 4. Accordingly, in the lower tier stands of the stadium, the capacity values are in accordance with regulations. Indeed, the capacity of lower west stand is 3979 and its evacuation time is 5,44 minutes. The capacity of lower east stand is 4269 and its evacuation time is also under 8 minutes by 4,08. The lower holding capacities and the higher number of evacuation route alternatives are the most important factors to diminishing the evacuation times in these stands. In addition, the relatively narrow stand staircases (6) in lower west stand could be considered as the biggest reason for the difference between lower west and lower east stands' evacuation times.

The upper tier stands have higher evacuation times than lower tier ones, because the pitch and its evacuation halls is not available to use for upper tier stands. While the total width of evacuation routes in lower tier stands is nearly 20 meters more than ones in upper tier stands. At this point, the upper west VIP stands is evaluated in different aspects. Because in this stand there are 4 vomitory 2,50 meters wide each and the capacity/total bottleneck width ratio is respectively more than any stands in the stadium. On the other hand, the ticketed spectators can use only 2 vomitories in stand. Otherwise, they must pass along the rows to access other vomitories, and this is not ideal for faster evacuate because there will be probably overcrowded in extraordinary situations. Thus, although the upper tier minimum evacuation time is calculated in upper west stand by 9,05 minutes, this time is not provided by regulations as it is above the 8 minutes limit. It is followed by 10,07 minutes in upper north stand. The regulation criteria should be provided by remove 1051 seats in upper north and 3242 seats in upper south stands. Thus, the evacuation times could be exact 8 minutes. The highest evacuation time of case study is 14,38 minutes in upper south stand. The most important factor for this situation is the high number of seats. The evacuation time of the upper east stand is also 3,49 minutes higher than regulation limits because of the same reasons.

As a result, all 8 stands that analyzed for the case study, the final capacity of the stadium should be up to 32,094. So, 6435 seats at least should be removed. Although the measures to be taken to determine safe capacity are specified in the regulations, the occurrence of different results in case study is based on some reasons below arising from the safety audit and certification process;

- Some requirements and standards specified in regulations are open-ended such as P or S factors used to determine holding capacities. These could be applied partially by subjective opinions of local authorities. Thus, the implementations vary across stadiums in different cities or countries.
- The safety audits are approved based on various titles/items varying according to their degree of importance on the stadiums, the approving the stadiums at certain threshold values based on the percentage calculations made on these items, and therefore the number of the criteria that are approved, could be reduce the negative

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effect of criteria are not provided.

- The possibility of the differences between the standards that are regularly updated in the process and the standards applied in the last safety audit. In this situation, some stadiums could be used with former standards for a brief time.
- International football authorities, such as FIFA and UEFA, may tolerate local authorities in stadium capacities, which are used in local leagues.

Each stadium that is planned to be used in the competitions organized by FIFA and/or UEFA is inspected by the football authorities in line with the regulations since the project process. In addition, as mentioned above, these stadiums are regularly re-inspected, capacity and safety data are checked, and necessary changes are made. In this study, the fact that the Konya City Stadium capacity data are different does not mean that the stadium is not built-in accordance with the regulations. Since the contracts between the UEFA officials and the local football federation are completely closed to the public or it has been a long time since the last inspection, the capacity values in the stadiums may vary at the levels determined in the study. The main goal of the study is to evaluate the interventions that can be made to increase the existing capacity and/or to make the stadiums safer, to the spatial arrangement methods made to achieve safe capacity in an international degree stadium.

Nevertheless, the results obtained from the study were evaluated in different perspectives. Accordingly, two main actions are recommended for stadiums that need to be refurbished in terms of security and meet the regulation standards in total evacuation times. The first of these; each independent section is evaluated within itself, and the number of available seats is gradually reduced, especially starting near the evacuation routes. Because, as seen in Konya city stadium, the most restrictive elements, especially in the lower stands, are the radial gangways. The least costly and most practical way to increase the width of these elements may be to reduce the seats around these routes as necessary. Thus, both the total route widths increase and the



Figure 6. The Open (Closing) (a) and Closed Position (b) of a Stadium Seats, which have Retractable Telescopic Frames (Figueras Engineering, 2021), The Circular Ramps in the Telstra Stadium Sydney (John et. al., 2007) (c) and the San Siro Stadium Milan (Deiana, 2019) (d), The Retractable First Ring Stands in the Stade de France (Whetstone, 2011) (e), The Pivoting Stand Parts of Tottenham Hotspur Stadium (SCX, 2021) (f).

capacity decreases. On the other hand, it may be quite reasonable to place retractable seats in these areas in local leagues.

The second action is to increase the spatial size, or the number of bottlenecks identified in the evacuation plans. It is quite easy to carry out these interventions in accordance with the instructions in a stadium structure that has not yet been built and is in the planning stage. However, the methods that can be used to achieve the required level of security in an already built stadium are becoming more sophisticated. In FIFA's 'Football Stadiums Technical Recommendations and Requirements', DCMS's 'Guide to Safety at Sports Grounds', and in the USA, Germany, UK etc. in the design guides of private sector veterans, the most common solution method focuses on demountable structures. With this method, both the capacity level can be controlled, and the dimensions of the evacuation routes can be changed simultaneously.

Some structures in stadiums may be erected for a single event only and may be commissioned at short notice. Structural components are lightweight, rapidly assembled, readily dismantled, and reusable. The most common method is to make some seats demountable/ retractable. This idea evolved in the 1960s from the attempt to house American football, played on a rectangular pitch, and baseball, played on a diamond shaped pitch, in the same building. Movable seating can be supplied in any numbers, from a few hundred to several thousand, to suit the types of events anticipated and the configurations required. The most usual type is retractable seats on folding or telescopic frames (Figure 6.a,b).

The dual stadia complex of Kansas City, Missouri was opened; this included two stadia, one of 78.000-seat (some of them are movable seats) capacity to be used for American football, the other of 42.000-seat capacity for baseball. Thus, the most ideal and safest capacity-seat arrangement has been provided for two types of events that require different spectator viewing angles. Toronto Skydome which opened in 1989 and can be adapted, by movable seating, to the following uses. The stands configurations allow 10.000 to 68.000 spectators for different exhibitions. One another example is the Pro Player stadium in Miami which accommodates football as the primary sport, and baseball as a secondary use in different capacity levels by using movable seats. Another example of pre-construction methods is the Telstra Dome stadium in Melbourne. While the upper stands of the stadium are reinforced concrete and fixed, the lower stands are planned with a steel structure and can be moved to obtain different capacity values. However, this solution cannot be considered for fieldwork as it requires the reconstruction of some of the stands in the already-built stadiums.

Stairs have the advantage of being the most compact method of vertical circulation in plan and as a result the easiest to design according to a scheme. But they have the disadvantage of being arguably more dangerous than ramps in

an emergency. It should be planned in pairs, if possible, the two stairs preferably sharing a common landing so that there is always an alternative route if one of the stairs is blocked. Furthermore, spectators are less likely to lose their feet on a ramp than on a ladder, and if they stumble or fall, the consequences will be less serious than on a ladder. Ramps are an ideal method to allow service vehicles to move from one level to the next. Also, they allow easy passage for wheelchairs and transportation of sick or injured spectators to the exits during events. Shortly, ramps are a safe, convenient, and increasingly popular way of transporting large numbers of people to different levels of the stadium, and circular ramps are the most common form. The corners of the stadium are the most usual position and successful examples include the circular ramps in the Telstra Stadium Sydney (its capacity is 82.500) (Figure 6.c), the Joe Robbie Stadium USA (65.000), and the San Siro Stadium Milan (80.000) (Figure 6.d).

Most restrictive elements in the upper stands' evacuation routes, which do not meet the 8-minute regulation requirement in Konya City Stadium, are mostly upper stand staircases. The reason for this situation is that the dimensions of these elements are not sufficient and the number of spectators who can use it per meter-per minute as a regulation constant is limited to 60/66 since they are stairs. If circular ramps are used instead of stairs for these stands, both the unit widths can be increased, and the regulation constant can be increased to 82/100. Thus, the total evacuation times will be greatly reduced. Aside from reducing the capacity, it is highly probable that even capacity increase in these stands can be allowed.

Apart from the specified capacity control applications, there are also stadiums that offer different capacity solutions around the world. Manchester City Stadium was designed to host the 2002 Commonwealth Games and was home to Manchester City Football Club in August 2003. Following the Commonwealth Games, a longterm future for the stadium was secured with its conversion into a football stadium capable of hosting rugby matches as well as other performance

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and community events. This transformation was achieved by completing the northern section of the bowl and excavating to create a lower seating layer, increasing the seating capacity from 38 000 to 50,000. The entry-exit and evacuation routes of the new stands are completely separated from the other stands. Thus, there is no disadvantage in terms of total evacuation time. However, to carry out this application, an athletics track, etc., must be established between the pitch and the stands beforehand. It is necessary to have add-ons and provide the necessary free space. This situation cannot be applied to Konya City Stadium. A similar example is the Stade de France, originally built in 1998. Multifunctional 80,000-seater stadium originally built for both football and rugby due to the elliptical shape of the stepped seating arrangement. Naturally, it allows the spectators to get closer to the field and especially to the goals. But it can also be adapted to a wide variety of athletic events. The 25,000 seats of the first ring stands are movable and can be mechanically retracted 15 meters and rolled on a cushion of air, steel, and Teflon cylinders (Figure 6.e). It is possible to apply this method with smaller stand parts for the Konya City Stadium. Especially on pitch evacuation gates (as can be seen in Figure 6.f of Tottenham Hotspur Stadium). However, the cost is the biggest question mark in this solution.

Based on the conclusions of this study, to prevent local football culture from stadium disasters, the structural and operational audits in the stadiums should be more qualified and the community should be continuously informed about all kinds of scenarios that may occur in the stadiums. The absence of a similar tragedies in the process from past to the present has caused the possible disasters could be happen in stadiums to be forgotten over time. This study, which includes capacity evaluations and calculations over Konya City Stadium, emphasizes the importance of the stadium on an international scale, in a way, with its use in international competitions and its inspection/approval by UEFA.

FIFA and UEFA maintain similar procedures for large-scale competitions at these stadiums of their member federations. Thus, all official regulation standards valid for Konya City Stadium are also valid for stadiums at the same level around the world. For this reason, it is desired to contribute to the international literature with the calculations, evaluations, and refurbishment suggestions within the scope of the study.

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After completing her B.Sc. (2010) (Hons) and M.Sc. (2015) degrees in Istanbul Technical University Department of Industrial Design, Aysun ATES AKDENIZ completed her doctorate in the same department with her thesis titled "Developing student performance in industrial design studios through self-regulated learning strategies" in 2022. She is a research assistant at Istanbul Bilgi University since 2014.

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Miray Boğa (PhD Candidate) is a member of the Department of Industrial Design at Istanbul Technical University. She is about to complete her Ph.D. at the same institution where she received her MSc. degree. The main research interest of her is the relationship between design and bio-approaches.

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I graduated from the Department of Architecture of the Seraj Higher Education Institute in 2009 with a bachelor's degree. Then I worked as a project architect in different architectural offices in Iran and Turkey, including my own office. I graduated from Gazi University, Department of Architecture in 2016 with a master's degree. Then I started to PhD education in History of Architecture at Istanbul Technical University in 2017 and graduated in 2022. I have articles in various journals related to my research area.

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In 1998, Asli Sungur graduated from Yıldız Technical University Faculty of Architecture, Department of undergraduate Architecture education, in 2001 she graduated from Istanbul Technical University Department of Architecture graduate education, and in 2006, from Yıldız Technical University, Department of Architecture doctoral education completed. She has been working as a lecturer at Yıldız Technical University Faculty of Architecture, Department of Architecture, Building Information Department since 2001.

Funda TAN

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Gülname TURAN

Gülname TURAN (PhD) is a member of the Department of Industrial Design at Istanbul Technical University. Her research, publication and practice areas include product design, crafts, design history, theory and education, empowerment of vulnerable groups through design and social innovation. Turan is currently a board member of the Turkey Design Council.

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