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Sustainable Design in Building and Urban Environment

Edited by
Farshid Aram

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Editor

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Cover image courtesy of Farshid Aram

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About the Editor

Farshid Aram

Dr. Farshid Aram obtained his PhD in the Sustainability and Urban Regeneration program at Politecnica Universidad de Madrid. He is a faculty member of the Urban Planning Department at Urmia University. In particular, he has published in four high-ranked journals (in the top 10% of Scopus rank): *Habitat International*, the *Journal of Climate Risk Management*, the *Journal of Urban Studies*, and the *Journal of Engineering Applications of Computational Fluid Mechanics*. Dr. Aram has invented software (Aram Mental Map Analyzer) to measure citizens' mental cognition in urban spaces through mental maps. He has two other patents in the field of architecture and urban design. He is a member of the editorial board of journals indexed in WOS in the field of sustainability and environmental resources, and has been the guest editor of four reputable journals during 2021–2023. Dr. Aram has reviewed articles for high-ranking journals in the field of Urban Studies and Architecture.

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Editorial

Sustainable Design in Building and Urban Environment

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The basic objectives of sustainability are to reduce the consumption of non-renewable resources, minimize waste, and create healthy, productive environments. Sustainable design in construction seeks to reduce adverse impacts on the environment and the health and comfort of people in buildings and urban areas, thereby improving the performance of buildings and urban spaces.

Sustainable design principles include the ability to optimize site potential, minimize non-renewable energy consumption, use environmentally preferable products, protect and conserve water, protect and enhance green resources, enhance the indoor and outdoor environmental quality, and optimize operational and maintenance practices.

Utilizing sustainable design principles encourages decisions at each phase of the design process, aiming to reduce adverse impacts on the environment and people's health without compromising the bottom line. It is the integrated, holistic approach that encourages compromise and tradeoffs, with such an integrated approach positively impacting all phases of an urban environment's life cycle, including design, construction, operation, and decommissioning.

As the editor of this Special Issue "Sustainable Design in Building and Urban Environment", I was pleased to receive several interesting research papers and review articles. This collection consists of a wide range of studies from different parts of the world, from South American to European and Asian cities, all accomplished in the fields of civil engineering, architecture, and urban planning. These studies introduced different methods regarding sustainable design from new techniques using computer simulation and artificial intelligence to studies on the traditional method of historical sites. In this Editorial paper, we present an overview of the main findings and conclusions of the included articles.

da Costa et al. [1] highlighted the issue of the large number of retired containers stacked in ports worldwide and the need for sustainable strategies for their use. Repurposing these containers into permanent structures, such as container houses, has become a popular trend. However, due to the urgency in disaster situations, container houses are often built quickly without considering energy efficiency principles. This can lead to performance issues, including overheating, corrosion, and rust, which further impact the vulnerable populations they serve. The objective of this study was to compare the performance of two thermal insulators applied to a temporary shelter container designed to promptly serve vulnerable populations. The researchers used Building Information Modeling (BIM) software and Building Energy Simulation (BES) software to simulate and analyze the technical and economic viability of the model. The results indicate that thermal insulators, particularly mineral wool, can significantly reduce energy consumption and improve long-term performance [1].

In a similar study regarding containers and tiny houses, Nezzi et al. [2] examined the relationship between the perceived knowledge and sustainability in the evaluation of a sustainable product, specifically a tiny house prototype. The study utilized a questionnaire to assess the quality, creativity, appropriateness, and sustainability of the tiny house. Unlike previous research that focused on direct sustainability-related information, this study provided sustainability information in an indirect and diffuse form. The majority

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of evaluators were ordinary people, with a limited number of experts in the field, making the sample representative of the general population. The findings indicated that prior knowledge and background did not significantly influence evaluations. However, gender and age had an impact, with women and younger participants rating the tiny house higher in terms of sustainability and other factors. The evaluation criteria were found to be significantly correlated, particularly in terms of perceived sustainability, preference, and creativity [2].

Cabeza-Lainez et al. [3] introduced a system called DianaX for architectural simulations that considers volumetric and three-dimensional properties, as well as energy sources involved in energy exchanges within and around buildings and urban spaces. The system is based on advances in optics theory, building upon assumptions of different studies in this field. The system utilizes complex integral equations to solve for radiated energy and offers advantages in terms of clearer visualization and analysis of building performance. The software can be considered a Design Tool, enabling the assessment of heritage building paradigms and the potential of new projects with unconventional lighting approaches. The main finding of this research was the feasibility and appropriateness of this method for addressing the problems at hand. The authors express their intention to expand the catalog of designs that can benefit from the use of their tool for scientific design in the future [3].

Given the new techniques of sustainable design, Yu et al. [4] provided a comprehensive review of recent research on the use of immersive virtual environments (ImVE) in architectural design collaboration. The study identified, screened, and reviewed 29 journal articles published since 2010, focusing on three aspects: ImVE in the architecture, engineering, and construction (AEC) industry, ImVE for supporting virtual collaboration, and applications of ImVE in design collaboration. The review highlighted the need for future research and technological development in areas such as ImVE support for design collaboration at the early design stage, cognitive research on design collaboration in ImVE, and enhancements to ImVE technologies to incorporate advanced design features.

In this regard, through using artificial intelligence techniques, the study conducted by Jayabalan et al. [5] discussed the use of steel plates in various engineering fields and the importance of considering buckling as a failure mode. It focused on rectangular steel plates with centrally placed circular openings and different support conditions. The study utilized artificial intelligence techniques, including Gene Expression Programming (GEP), Artificial Neural Network (ANN), and Evolutionary Polynomial Regression (EPR), to predict the critical buckling loads of these plates. Datasets from the literature were compiled and used to develop the models [5].

Another study [6] assessed the use of in-filled tubes, specifically steel shell tubes filled with concrete, as a successful configuration for axially loaded members like columns and struts. This configuration offers advantages such as eliminating the need for shuttering, reinforcement bars, and ties, while increasing flexural and axial capacities and enhancing ductility. However, a main disadvantage is the potential for local buckling and decomposition. Previous studies have explored solutions using intermediate stiffeners or shear connectors. This research proposed a different approach using double cold-formed sigma sections as steel shell tubes. Sixteen specimens with varying lengths, cross-section dimensions, and shell thicknesses were tested under concentric and eccentric compression loads. The results recorded ultimate capacities, lateral deformations, and normal strains. Theoretical capacities were calculated using different standards and software, with deviations from experimental results ranging from 13% to 24% [6].

According to the necessity for the development of appropriate standard projects for providing highways with roadside service facilities and increasing efficiency, Samoilov et al. [7] suggested interconnecting space-planning solutions based on a triangular module instead of a square or rectangular one. According to the results of this research, the use of this modular system can help reduce the harmful impact on the environment and effectively utilize renewable energy sources [7].

The research conducted by Mangeli et al. [8] focused on rock-cut architecture, a lesser-known type of vernacular architecture that differs from conventional architectural practices. The study aimed to explore the techniques, designs, and excavation procedures employed in this type of architecture. The research compares and contrasts the techniques, types, and settlement context materials, recognizing three general excavation techniques. The main case study was the Meymand residential complex, the largest rock-cut complex in Iran. The study examined 50 residential units in the oldest part of the village, analyzing techniques and design styles and comparing them [8].

Regarding the importance of public spaces and green areas on the mental and physical health of individuals, with a focus on thermal comfort as a key indicator, Baquero Larrivaand Higueras García [9] examined the outdoor thermal comfort of older adults in Madrid, Spain, and Newcastle upon Tyne, United Kingdom, during the autumn season. The study utilized a mixed methodology involving environmental measurements and surveys conducted on-site. The findings of this research highlighted the need for the design of more comfortable and healthy public spaces that enhance the quality of life for all citizens, aligning with the principles of active aging and healthy cities [9].

In the study conducted by Abouelela [10], the focus was on investigating the relationship between the work environment and job happiness at King Faisal University. The researcher aimed to understand the opinions of faculty and staff members regarding their environmental and functional needs at work, with a specific focus on improving the interior design of workspaces to create happiness in the work environment. Overall, this research emphasized the importance of the work environment in shaping individuals' happiness and quality of life. It provided insights into the factors that contribute to job satisfaction and highlighted the role of organizations in creating a conducive work environment that fosters happiness and encourages innovation and creativity [10]. In a similar study [11], the importance of interior design in academic libraries, specifically in the context of college and university libraries, was discussed. This research indicated the need for academic libraries to evolve from being mere repositories of books to becoming spaces for research and communication [11].

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Article

The Effectiveness of the Role of Interior Design in Creating Functional and Institutional Happiness for Work Environments: King Faisal University as a Model

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Abstract: Happiness is a natural human right that all seek to achieve. The quality of people's lives may be directly affected by the quality of their working life, which is affected by the quality of their work environment. This has become the focus of attention of work institutions in society due to its great importance and strong impact on success. The purpose of this study was to investigate the institutional work environment at King Faisal University by surveying faculty and staff members regarding their opinions on meeting their environmental and functional needs at work by improving the interior design of workspaces to create happiness in the work environment. The aim of this study was to reveal the relationship between employees' performance levels and their work environment, in addition to making happiness and quality of life major priorities and creating a stimulating work environment. The researcher used descriptive analysis to analyze the relationship between aspects of work and the levels of job satisfaction and happiness among employees of King Faisal University. The researcher used a five-point Likert scale to measure the responses to the questionnaire items, and reached several conclusions, including that the level of job happiness at King Faisal University is not affected by the variables of gender, social status, or the nature of the job, and that the university provides a work environment that helps achieve job happiness and allows for job innovation and creativity.

Keywords: happiness; job happiness; quality of life; workplace; healthy interior design; office breakout area furniture

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1. Introduction

Happiness is a word with two connotations. One is experimental and refers to the psychological condition in the present moment and a feeling of positive emotions, such as joy, enthusiasm, love, and hope. In this context, happiness lies in overcoming negative feelings with positive feelings. The second connotation is evaluative; people think about the happiest moments in their lives, as happiness is the aspiration of every human being. According to Mayer and Diner (1995), happiness can be defined as the experience of frequent positive affect, infrequent negative affect, and an overall sense of satisfaction with life as a whole [1]. The British philosopher David Hume said, "People do not pursue professions, acquire antiques, invent inventions, or publish sciences, or contemplate the stars, except to reach happiness . . . either by toil and trouble, or money and wealth, or laughter and singing." Happiness is defined by the Oxford English Dictionary (Hawker and Waite, 2007) as "a state of mind or feeling comprising contentment, satisfaction, pleasure or joy." It is further described as the state of a pleasurable content of mind, which results from success or the attainment of what is considered good. Satisfaction is another word that is frequently used interchangeably with happiness.

The Oxford Dictionary defines satisfaction as "the feeling of pleasure that arises when you have the things you want or need or when the things you want to happen" [2]. Happiness is defined as the feeling of permanent and integral satisfaction with life as

a whole [3] and is also seen as a positive feeling and a powerful motivator of human behavior [4]. The simple concept is that happiness describes the extent to which a person can measure and judge the quality of his or her life positively [5]. Aristotle defined happiness as life with meaning, purpose, and ends. Several books and studies have been published confirming that happiness helps us be more productive, as it helps us think creatively and work efficiently.

Happiness in the workplace has become very important and is related to the present societal context, crucial to both employees and institutions. People will spend more of their adult life at their job than doing anything else. Work will take up more time than families, friends, and hobbies combined. It would be nicer if that time were spent at a job that actually makes them happy. Happy people and happy institutions can create many good things, such as increased productivity, quality, customer satisfaction, creativity, innovation, adaptation, and flexibility, and decreased loss, work stress, and occupational diseases [6].

Happy employees can quickly solve the problems they face constructively since happiness positively affects human behavior. Happiness is an internal feeling of joy and pleasure that is externally reflected in employees' behavior and mood and appears in their reactions to colleagues. Happy people deal with everyone around them positively and accept what is going on. The efficiency of administrative institutions at universities generally depends on the efficiency of the people within them and their ability to work. The level of happiness of people at work affects their performance and success at the institution to which they belong.

Job happiness is reflected in employees' daily work by a feeling of comfort, calm, and positivity in participating in the work they are assigned to perform. Job happiness also helps employees face and overcome challenges [7]. A work environment is described as happy when employees often experience positive feelings there [8].

Happiness in the workplace is closely related to the development and innovation of today's societies. It is not just a feel-good thing, it is really, according to Plato "for man to be happy" [6]. Workplace happiness refers to "an individual's work and life satisfaction" or "subjective well-being" at the workplace [9,10]. Workplace happiness includes job satisfaction as well as individual measures of happiness involved in work [11]. Happiness at work is the feeling that employees enjoy what they do and are proud of themselves; they enjoy having other people around; thus, they give better performance. It is not an administrative luxury; thus, it is necessary to understand happy practices, which are one of the keys to institutional development and a factor of success for the beneficiaries. In addition, the institution can bring happiness to its employees by focusing on the interior design of the workplace along with the employees and those who deal with them, as all of these elements are linked and affect each other.

Quality of life, or wellbeing, is a concept closely linked to happiness, but it is a self-contained concept. In addition to happiness, it also has an empirical sense and refers to how people evaluate their lives and the source from which they derive their sense of purpose. Quality of life is not only about individuals' feelings but also about their performance on the personal and social levels. Robert Levering, the founder of the Great Place to Work Institute, said that a great workplace is where you feel confident in the organization you work for, proud of what you do, and joy working with the people you work with [12]. The more people are satisfied with their work and life, the more it impacts their happiness at the workplace. Happiness is important and has an impact on the success of any institution, which always strives to maintain happiness within the work environment by knowing and studying the factors that affect employee happiness to enhance it because of its remarkable impact on increasing productivity [13].

Institutional happiness is not a new concept but rather an extension of the concept of internal communication in public relations focused on making employees happy in the work environment; the new concept is happiness in institutional work in which all sectors participate. A creative and innovative environment contributes to employees' happiness, and they are more creative, focused, and able to lead and face challenges. Creative and

innovative people are more productive. Research and practical experience have proven that employee happiness should be a priority. Happy employees mean higher productivity, better production quality, better reputation, competitive advantage, and sustainable success, which leads to happy customers. Accordingly, governments, private institutions, and civil society organizations play a role in creating a stimulating, appropriate, and happy environment for employees thus that they can provide services that exceed customers' expectations and requirements.

Entertainment in the work environment motivates employees to come up with great ideas by having fun games to play during their break time. Happiness is a basic requirement that everyone strives to achieve, whether at work or otherwise.

Some surveys have shown that happy employees stay four times longer than dissatisfied employees, and happiness plays a big role in their being 12% more productive than unhappy employees; they enjoy performing their job duties. Employees who are happy at work exhibit higher levels of job-related performance when compared to employees who are unhappy in the same work environment [14].

Interior design related to human health and wellness focuses on all of the design elements used, including materials, lighting, and colors, along with studying air and sound quality, paying attention to green spaces and achieving integration between exterior spaces and the interior environment to achieve the desired result [15]. Interior design greatly affects people's feelings about interior spaces; feeling cramped and trapped will affect the creativity and productivity of the occupants of the space. One of the elements that has a dramatic effect is the height of the ceiling, as high ceilings improve focus and creativity and enhance mood and improve the air quality and space. Functional space, natural light, security, and safety exit [16].

The physical environment has a clear impact on individuals and their health, and both individuals and groups have needs in the work environment, and they must be well understood to provide a safe and comfortable environment. In interior design, some elements can affect mental health, such as color, which can affect people's mood when they are in offices or in workplaces in general [17]. Experienced interior designers understand how design affects mental health and that it is necessary to consider the design criteria of spaces, what requirements employees have for their offices, and whether the current design reduces tension or causes it, and then take into account modifications in the proposed design. Lighting is one of the most important elements of interior design that must be achieved optimally, whether natural or artificial, as lighting affects the feeling of functional comfort and the level of performance of tasks. Appropriate types of lighting must be provided, using materials according to the functional nature of the place [18]. Interior design generally has a role in helping the occupants of a building to feel comfortable and calm through aesthetic and functional aspects, taking into account the physiological and psychological factors of occupants of different buildings with different functions.

2. Literature Reviews

There are many recent literature reviews in the field of academic library space design. In this study, we reviewed several studies that benefited from its most prominent features. It should be pointed out that the studies that were reviewed were published between 2002 and 2018 in several countries, which indicates their temporal and geographic diversity.

In the following, we present a summary of these studies, then we explain what the current study offers by identifying the differences between it and previous studies, and finally note the aspects of previous studies that benefit the current study.

Wasarat and Sharif (2014) noted that happiness in the workplace refers to how satisfied people are with their work and life. Happiness represents the feeling of subjective wellbeing of the individual. Achieving happiness in the workplace is very important for improving productivity. Happy people are productive people, while those who are unhappy may not pay full attention to their tasks. Some scholars also believe that organizations that work to maintain workplace happiness in the long term are able to increase productivity. In

order to achieve this, the employees must know the factors that affect happiness in order to effectively promote it in the work environment. The researchers also noted the scarcity of research on employee happiness in the past and presented a conceptual framework for happiness in the workplace [13].

Tosiriwatanapong (2014) positioned wellbeing as one of the success factors in the workplace. Given that people's body, mind, and spirit are linked to the physical environment, a well-designed workplace can increase the wellbeing of employees, which leads to increased productivity of the work organization. The design has a great role in helping employees deal with their feelings within the work environment and can promote positive feelings. The study focused on contemporary health themes, with the objective of finding out the emotional insight of designers regarding the physical environment at the workplace and identifying its characteristics. Working with designers in various specialties, the authors conducted in-depth interviews with seven respondents and carried out an online survey questionnaire with 100 respondents using a convenience sampling method [19].

Akhtar et al. (2014) noted that better interior design was critical to increasing employee productivity in all business areas. They identified five dimensions in interior design: furniture, lighting, noise, temperature, and fixtures. The main objective of the study was to examine the relationship between office interior design, work environment, and employee productivity. They collected data from communications sector employees at the Sahiwal Division in Punjab, and a sample size of 200 was determined to conduct this research. The primary data were collected using a structured questionnaire, and then descriptive statistics analysis, correlation, and regression by SPSS were used to find out the effect of interior design on employee productivity. The results showed that interior design has a positive relationship with employee productivity [20].

In reviewing the literature, we noted that the current study agrees with previous studies on the main topic and its general objective, and it differs in several aspects, as follows.

This research differs from other research in that it focuses on revealing the opinions of King Faisal University employees about the interior design of the work environment with regard to achieving job happiness and their levels of satisfaction, as well as the importance of having places designed for rest during work, either outside the official workplace or not, and it collects and analyzes their proposals and needs that should be taken into account in developing and improving the interior design to achieve career happiness. We designed a questionnaire consisting of a set of questions about job happiness, its importance, the nature of interior design, and design considerations in office rooms, in addition to the availability of places designed for rest in the work environment. Then, opinions based on the questionnaire were collected and analyzed to identify the positive and negative points from the respondents' point of view.

3. Problem Statement

The problem lies in recognizing the importance of job happiness and determining how to create a work environment that brings job happiness to employees by spreading the concept of happiness and satisfaction. This study focused on the current work environment of the administration building at King Faisal University and how the administrators were working to create a happy work environment for employees. The two basic principles are the science of happiness and the science of design, which contribute to the design of the workspace to improve the quality of the internal environment and confirm the role of interior design and its effectiveness in creating a work environment in which the principle of institutional functional happiness is achieved.

4. Study Objectives

The aims of this study are as follows:

- Analyze the opinions of respondents through an electronic questionnaire on the concept of job happiness;

- Measure the effect of interior design on job performance and the work environment and its role in achieving job happiness;
- Discover how to create a happy environment for work through interior design thus that employees can feel happier in work and life;
- Study the relationship between the level of employee performance and the work environment;
- Determine how to make happiness and quality of life a major priority in the work environment at King Faisal University;
- Promote achieving the goal of spreading happiness in the workplace with practical and effective steps.

5. The Importance of This Study

The importance of this study lies in what it presents to higher education institutions about what a happy work environment is and the positive impact it has on university employees, including staff and faculty members. It emphasizes the role of a happy work environment in achieving career happiness and its impact on increasing employee performance and job efficiency, which affects the productivity of the institution. After analyzing the results of the questionnaire, which clarified the current situation at King Faisal University and the hoped-for situation of its employees, some proposals are presented.

6. Study Limitations

Time: The second semester of the 2021–2022 academic year was chosen to implement the study tool. Sample size: the study was limited to a random sample of King Faisal University employees. Location: King Faisal University. Subject: the effectiveness of the role of interior design in creating functional and institutional happiness for the work environment was investigated using King Faisal University as a model.

7. Study Questions

The study sought to answer the following research questions:

- Is the current internal work environment conducive to achieving job happiness?
- What is the effectiveness of the role of interior design in creating functional and institutional happiness for the work environment?
- How can employees be encouraged to reach their highest levels of happiness and quality in the work environment?
- What are the future vision and proposed solutions to achieve functional and institutional happiness in the work environment?

8. Materials and Methods

The researcher used the descriptive analytical method to study and analyze the levels of satisfaction and happiness at an educational institution (King Faisal University) through an electronic questionnaire answered by an exploratory sample of university employees.

9. Study Tool

The appropriate tool was chosen, a questionnaire, to survey employees of King Faisal University on their opinions about job happiness in the institutional work environment, and the required data were collected through their responses to the questionnaire. The questionnaire was divided into five main sections, each consisting of a set of questions. Out of the total sample of university employees (N = 100), 57 responded to the questionnaire.

The five sections of the questionnaire were as follows: (1) administrative spaces (administrative offices for employees); (2) interior space planning for offices; (3) availability of natural and artificial lighting sources; (4) materials and colors; and (5) rest areas within the work environment.

The researcher used the Likert scale, which is widely used in most fields of science to measure tendencies, desires, and attitudes, as well as to measure behaviors and preferences

in psychological tests [21]. It is scored from 1 to 5, with 5 indicating "strongly agree" and 1 indicating "strongly disagree," and the scores were used to calculate arithmetic indicators and averages by computer analysis programs to derive results from questionnaires and research.

A 5-point Likert scale was used to measure the responses to the questionnaire items. The scale in this study is shown in Table 1.

Table 1. Five-point Likert scale.

Response	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Degree	1	2	3	4	5

The importance of happiness and quality of life in the work environment can be described as follows:

Delivering Happiness

Delivering Happiness (DH), the leading company in spreading the concept of happiness and satisfaction among employees in the work environment is headquartered in San Francisco, California, USA. It worked with the government of Dubai to develop the Dubai Happiness initiative and provided consultations with many major international companies, such as Facebook, to help create happy work environments for their employees. Mountain View has announced its partnership with DH, which aims to create happy work environments for employees in Egypt and the Middle East. The company aims to use innovative ideas to design workplaces that bring happiness by utilizing modern science and studying the factors that affect the creation of happiness, and applying them to achieve the desired goals, including in the following areas.

Happiness and success

The feeling of happiness is transferable from one person to another. Employees who feel happy in their work environment and while performing their job tasks are great models for peers who do not feel happy or feel less motivated. In addition, happiness in the workplace is directly related to improving employee performance and thus increasing productivity.

Reducing stressin the workplace

Workplace stress is a growing concern as employees face overworking conditions, job insecurity, and low levels of job satisfaction. Workplace stress has been shown to have a detrimental effect on employee health and wellbeing and has a negative impact on workplace productivity [22].

Studies on stress reduction include the following:

- Kagan, Kagan, and Watson conducted a field study with 373 employees of the emergency medical service of a firefighting department that lasted 3 years. They developed a framework to define stress and classify programs to reduce psychological and educational stress. It consisted of seven psychological educational programs, each of which had a relative impact in the short and long term. Improvements were found before and after follow-up. The results of the study supported the value of psychological training programs for preventive mental health in the workplace [23];
- Smith and Sainfort aimed to propose a new way of conceptualizing job design and job stress based on the balance among job elements. They integrated social psychological theories of job design with job stress concepts to develop a model of job balance that addresses how the organization and job design can influence worker health. The model defines how job design can improve "loading" factors on the worker by "balancing" aspects of the job that can produce stress. The implications of this model for enhancing worker health by controlling workplace stress are discussed. The model provides a holistic approach for designing workplaces that balance aspects of production and stress [24].

Enjoying happiness in the work environment helps to reduce the feeling of stress, and on the contrary, unhappiness affects positive feelings and leads to an inability to think creatively and logically.

Happiness and positivity at work

Happy people are more creative and inspiring and have a positive effect on those around them; they can create an enjoyable work environment that helps others integrate and work in it and increase the number of members of the work team [25].

Design standards for administrative buildings

Modules in administrative offices: when designing administrative buildings, it is necessary to rely on modules in the floor plan, in the facades and sections, whether the building is brick, iron, aluminum, glass, or reinforced concrete. The designer chooses the module that gives the best solution for the building for which the interior design is intended, and this module depends on the area of the space, which can be determined by the number of people who work in it and the type of work they do. It is possible to use natural lighting in an office to a large extent, and accordingly, it is possible to determine the appropriate areas for each purpose for which it is used. Administrative buildings must meet some conditions in the design process, such as:

- The type of floor plan (open, closed) as Figure 1 according to the nature of the building;
- The number of employees in the different departments in the building;
- The number of public users of the building;
- Various services in the building (toilets, offices);
- The safety of the building indicated by the presence of escape ladders to be used in emergencies.

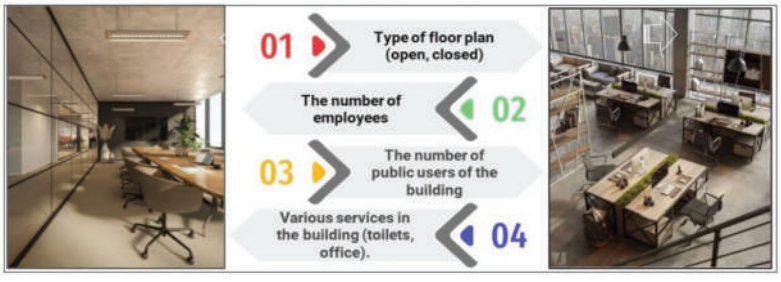


Figure 1. Interior design of open-plan and closed-plan offices. (1) https://www.behance.net/gallery/68740375/Loft-style-furniture-part-5?trackingid=T32PLY3L&mv=email/ (accessed on 15 March 2022); (2) https://www.flickr.com/photos/lemeridienhotels/8427593833/in/photostream (accessed on 10 March 2022).

Foundations and standards for office interior design

Administrative offices are designed based on several criteria:

- The interior design should be appropriate to the nature of the work;
- They should provide a suitable work environment for employees and clients;
- The results of studies of the office space and windows should be used to determine the lighting and the nature of the work;
- There should be an appropriate distribution of the internal space of the administrative office to comply with the requirements of the nature of work and maintain movement corridors;
- The appropriate colors should be chosen for the nature of the work;
- Appropriate materials should be used for ceilings, walls, and floors.

The main elements of office design

- Flooring: it is preferable to use wooden floors, with carpets or rugs in managers' offices;

- Ceilings: it is important to choose materials intended to silence external sounds and to use roof materials that are resistant to moisture and heat;
- Walls: the colors used on the walls must be light because dark colors have an effect on employees' creativity in their work;
- Accessories: office accessories such as lampshades, vases, office sets, portfolios, artboards, and curtains should be provided.

The design of a good work environment depends on matching the work and the environment with the needs and requirements of the employees shown in Table 2, and these requirements include a set of variables that affect employee performance [12]. Employees generally want to contribute to the best of their ability because they believe in the importance of their work and their duty to accomplish it. However, employees are humans with universal human needs in the workplace; they need to have their contributions valued and their ideas respected. When these human needs are met in the workplace, people do their best, share, and contribute to delivering the massive returns that the most successful companies achieve [26].

Table 2. Needs and requirements of employees in work environment [26].

No	Physiological Needs	Psychological Needs
1.	Thermal comfort	Privacy
2.	Indoor air quality	Personal space
3.	Optical comfort	Physical space
4.	Acoustic comfort	Friendships
5.	Ergonomics	Telecommunications

Creating a productive and comfortable interior atmosphere

The concept of interior design for workspaces is based on the design of collaborative and impactful office spaces. Interior designers can understand the importance of the space by meeting the people who will be using it and learning from their experience of how the design can support them purposefully. With rapid changes, designers need to allow movement or rearrangement to create many types of spaces or ways in which people can work. Movement from one place to another may become increasingly important.

The interior design of the workplace significantly affects human behavior. Employees spend many hours in their offices every week. This can negatively affect their motivation and productivity if they do not feel comfortable and happy in their work environment. Paying attention to the work environment is one of the most important factors in achieving goals. Therefore, the standards of interior design for administrative spaces must be applied by providing good design, appropriate lighting and colors, and office furniture commensurate with the activities of the space, considering the impact, which is reflected in the thoughts and feelings of employees, whether they are happy to belong to the organization. The work environment is related to the creativity of its interior design, which is important for improving its level. The more the work environment is improved, the more the institution progresses [27].

There are four factors involved in designing co-working spaces:

1. Warm up the lighting with openings for natural light;
2. Create an audio spectrum by providing multiple options in terms of power and noise level that can vary according to activity and mood;
3. Create a work environment that feels like home with warm, attractive, and comfortable spaces with a connection to nature and natural materials;
4. Encourage spontaneous activities by designing comfort hubs that allow people to move in and out of the space and encourage them to stop and chat.

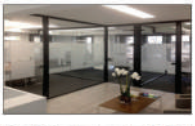
Advantages of glass partition walls

Glass partitions between rooms and corridors create more visual distraction than was there before as Figure 2; some see them as not providing the privacy needed in the work

environment, and they may be inconvenient and distracting for employees. There are many sophisticated and modern designs and shapes of glass walls used in open spaces, helping to create a feeling of spaciousness in the work environment. Glass walls are characterized by strength and durability, which means the possibility of shattering them is very low, and the interior design of administrative offices may require dividing the spaces using glass panels, which increase transparency between sections, and some can also help bring in daylight and enhance communication and cooperation between employees as shown in Table 3 [28].

Figure 2. Use of vertical glass partitions to divide office spaces. (1) https://archello.com/product/klarity-freestanding-glass-partition (accessed on 12 February 2022); (2) https://www.indiamart.com/bombayglass-delhi/glass-partition.html (accessed on 12 February 2022).

Table 3. Advantages of glass partition walls.

	Advantages	Illustration
1.	**Expansion of space and a feeling of lightness and spaciousness**	
2.	**100% safe and laminated** Many people believe that glass is fragile and not as strong as traditional walls, but it is safe and laminated, as well as environmentally friendly	
3.	**Possibility of sound isolation and optical transparency** As much sound insulation as traditional walls	
4.	**Space zoning at lowest cost** Glass walls are less expensive than traditional construction, take days to install, and have a more attractive look	
5.	**Increased natural light** Glass walls help to increase the amount of natural light and freshen the air.	

Work Break Environments

Office break furniture is an area separate from the official workplace, provided as a resting place for employees where they can spend time taking breaks during the official workday in a way that does not conflict with their job duties that is away from the offices and the official work atmosphere [29].

Modern work systems require employees to spend much more time in offices in front of computer screens. Health and safety laws require employees to take frequent breaks from screens during work hours. A break area is any open space for employees or visitors separate from the usual work area. It can be a place for employees to relax and have lunch or even hold casual meetings with other employees or clients. Different types of seats can be provided if the appropriate space is available, such as multi-purpose chairs or chairs around a central table; thus that there is a place for meetings or lunches and seating units to make employees feel comfortable and relaxed when taking a break [30]. Relaxation spaces are the most flexible spaces in the office. A rest area for employees should be in a strategic location where it is easy to move from one place to another. These places are intended for employees to feel comfortable and calm during their daily work. One of the rooms in the administrative building could be furnished with comfortable seating units designed in a way that helps people to rest, relax, renew, and restore their functional activity, along with motivational books with short positive phrases to meet people's various needs. Such spaces are suitable for grabbing a bite to eat or drinking a cup of coffee, meeting new customers, or greeting visitors. Giving employees casual areas to collaborate and brainstorm is crucial to their productivity and wellbeing. Break spaces are integral to any energized, creative workplace. A strong Wi-Fi connection is essential for any sub-area, but the technologies that employees need and use to get the job done must be considered. The basic principle in any mixed workspace with collaborative areas is that people should be able to carry on with their work. Technology must be seamless to achieve true collaboration in the workplace.

Design concept for breakout spaces

It is necessary to know the main requirements for the space and focus on the design. Research conducted by the Workplace Intelligence Unit indicates that having many side spaces does not represent an efficient use of space because the design does not match the primary function. Rest areas are often playful spaces that allow offices to show the lighter side of their work-life and bring out the fun side of the organization. When planning the interior design of the work environment using healthy materials, sound, smell, texture, and colors, these spaces can be indoor spaces as the aim is to reduce anxiety and enhance productivity as shown in Table 4 [31].

A happy work environment helps to generate positive feelings and a sense of peace, psychological comfort, and activity. In addition, it encourages participating with others, developing cooperative work, and working without paying attention to the time. When everyone spends time working without putting pressure on each other, it is a model of a happy environment that plans effective work and makes employees feel more productive.

Table 4. Design concept for breakout spaces.

No	Description	Figure
1.	**Quiet work space** Among high-performing employees, 58% say they need more quiet workplaces. A modern office environment should have quiet spaces. Flexible workspaces today need areas of calm that enable employees to be creative and focused on coming up with great ideas [32].	
2.	**Use of technology and charging devices** Technology is important in solving problems and managing files and reports, and modern workplaces rely entirely on technology to achieve work efficiency and reduce time and money problems, and accomplish required tasks [33].	
3.	**Relaxation, meditation** Meditation is a simple and quick method that helps reduce the stress of daily work while bringing a sense of inner peace [34].	

Table 4. *Cont.*

No	Description	Figure
4.	**Informal meetings** Informal meetings can be held to address issues, whether monthly, weekly, daily basis. Large chalkboards can be hung on a wall to present problems and ideas are presented, and share information [35].	
5.	**Brainstorming sessions** Brainstorming combines calm and informal thinking to solve problems, providing an opportunity and encouraging everyone to think innovatively. Interior design for a brainstorming space uses methods that focus on creative design and activities, which helps to evoke ideas by providing the best conditions [36].	

10. Discussion

This section includes the following: a presentation and discussion of the results related to the questionnaire filled out by employees of King Faisal University; data analysis related to the responses about the dimensions of job happiness and the role of interior design in achieving job happiness; and the process of identifying the consistency and compatibility among the respondents' opinions about the questions and clarifying them.

The researcher carried out several procedures, as follows:

In the first step, an electronic questionnaire was designed and prepared to gather opinions on the effectiveness of interior design in creating functional and institutional happiness for work environments, using King Faisal University as a model. The questionnaire was made up of five sections, with each section containing a set of questions or phrases. The Deanship of Scientific Research at King Faisal University was consulted to approve the ethics of the scientific research and agreed to send the questionnaire via e-mail to the university's employees.

In the second step, the researcher carried out the analysis by first determining the goal, which was to measure the extent to which job happiness was achieved in the institutional work environment at King Faisal University by analyzing the responses to the questionnaire by university employees. Next was determining the unit of measurement or counting to enumerate the analysis categories, which was the frequency of responses to each question in each section. The total sample size was N = 100, and 57 responded to the questionnaire.

The following are the results related to the first question: Is the current internal work environment conducive to achieving job happiness?

The statistical analysis of the 57 responses to question 2, shown in the first section of Table 5, indicates that 8% strongly agreed, 23% agreed, 13% were neutral, 8% disagreed, and 5% strongly disagreed as shown in Figure 3. Through these responses, it can be seen that they were aware of job happiness and their need for it in the work environment.

From the statistical analysis of the 57 responses to question 5 in the first section, the questionnaire (Table 5) indicates that 8.8% strongly agreed, 33.3% agreed, 19.3% were neutral, 22.8% disagreed, and 15.8% strongly disagreed as shown in Figure 4. From this analysis, it was found that the number who agreed and disagreed was almost equal. That is, the current internal work environment needs to be developed and improved to achieve job happiness.

The results related to the second question: What is the effectiveness of interior design in creating functional and institutional happiness for the work environment?

The statistical analysis of the responses to question 6 in the first section of the questionnaire (Table 5) indicates that 53.1% strongly agreed, 40.4% agreed, 19.3% were neutral, 1.8% disagreed, and 3.5% strongly disagreed. From this analysis, we can see the importance of interior design in the workplace. The analysis of responses to question 7 indicates that 59.6% strongly agreed, 22.8% agreed, 12.3% were neutral, 3.5% disagreed, and 1.8% strongly

disagreed as shown in Figure 5. From this analysis, we found that interior design affects job happiness in the workplace.

Table 5. Frequency of responses in the first section on administrative spaces (administrative offices for employees).

No	First Section Administrative Spaces (Administrative Offices for Employees)	SD	D	N	A	SA
1.	Do you know what functional happiness is?	4	3	12	13	25
2.	Do you feel functional happiness in your work environment?	5	8	13	23	8
3.	Does feeling happy in the work environment reduce the level of anxiety and help enhance productivity?	3	1	1	12	40
4.	Is job happiness a basic requirement for employees in the work environment?	1	3	2	9	42
5.	Is the current internal work environment suitable for achieving job happiness?	9	13	11	19	5
6.	Are you interested in the interior design of the workplace at your institution?	2	1	11	23	20
7.	Does the interior design of the workplace affect the achievement of job happiness?	1	2	7	13	34

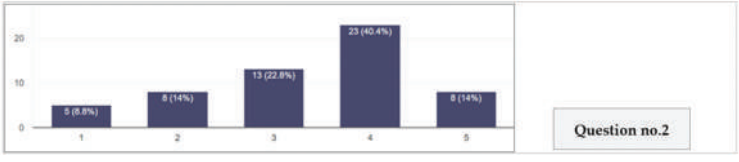


Figure 3. Analysis of responses to question 2 in first section.

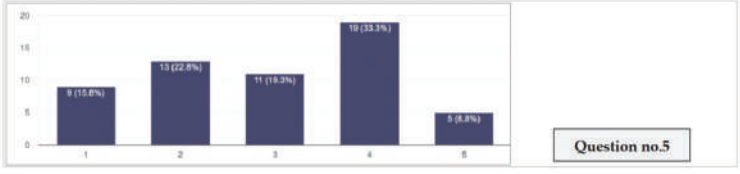


Figure 4. Analysis of responses to first question.

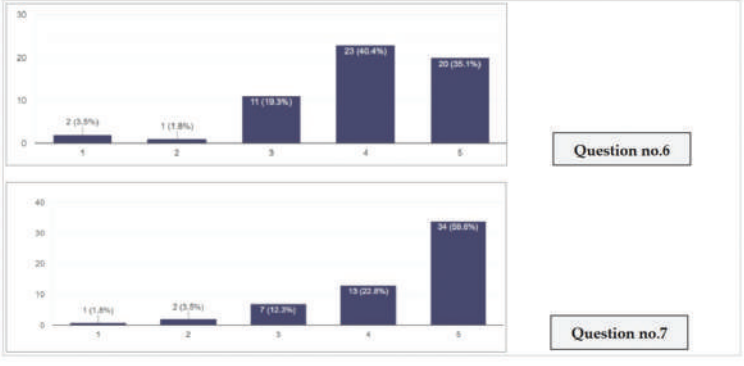


Figure 5. Analysis of responses to questions 6 and 7 in first section.

Table 6 shows the frequency of responses in the second section, office room interior (space planning), which consists of five questions. The analysis of responses to question 1 (Is the interior space of the office commensurate with the nature of the work?) indicates that 40.4% strongly agreed, 31.6% agreed, 19.3% were neutral, 3.5% disagreed, and 5.3% strongly disagreed. The analysis of responses to question 2 (Are the office furniture items available in the room appropriate to their size?) indicates that 29.8% strongly agreed, 31.6% agreed, 24.6% were neutral, 10.5% disagreed, and 3.5% strongly disagreed.

Table 6. Frequency of responses in the second section (Office room interior space planning).

No	Second Section: Office Room Interior Space Planning	SD	D	N	A	SA
1.	Is the interior space of the office commensurate with the nature of the work?	3	2	11	18	23
2.	Are the office furniture items available in the room appropriate to their size?	2	6	14	18	17
3.	Does the office furniture achieve aesthetic and functional aspects?	5	12	14	13	13
4.	Do the dimensions of the available office furniture items make you feel comfortable?	7	6	15	13	16
5.	Do the internal movement paths fit into the space of the office?	5	10	15	14	13

The analysis of responses to question 4 (Do the dimensions of the available office furniture items make you feel comfortable?) indicates that 28.1% strongly agreed, 22.8% agreed, 26.3% were neutral, 10.5% disagreed, and 12.3% strongly disagreed. The analysis of responses to question 5 (Do the internal movement paths fit into the space of the office?) indicates that 22.8% strongly agreed, 24.6% agreed, 26.3% were neutral, 17.5% disagreed, and 8.8% strongly disagreed. The analysis of responses to question 3 (Does the office furniture achieve aesthetic and functional aspects?) indicates that 22.8% strongly agreed, 22.8% agreed, 24.6% were neutral, 21.1% disagreed, and 8.8% strongly disagreed.

Statistical graphs of the data in Table 6 showing the analysis of responses to the second section are shown in Figure 6.

Table 7 shows the responses to the availability of natural and artificial lighting sources, which consists of six questions. The analysis of responses to question 5 (Does your office interior design make you feel private?) indicates that 49.1% strongly agreed, 22.8% agreed, 10.5% were neutral, 7% disagreed, and 10.5% strongly disagreed. The analysis of responses to question 4 (Do you prefer vertical partitions (walls) for the office room to be solid?) indicates that 45.6% strongly agreed, 26.3% agreed, 7% were neutral, 10.5% disagreed, and 10.5% strongly disagreed. The analysis of responses to question 3 (Is the current lighting for the office commensurate with the interior space?) indicates that 36.8% strongly agreed, 31.6% agreed, 14% were neutral, 7% disagreed, and 10.5% strongly disagreed. The analysis of responses to question 1 (Is there a source of natural lighting in your office?) indicates that 33.3% strongly agreed, 21.1% agreed, 8.8% were neutral, 1.8% disagreed, and 35.1% strongly disagreed. The analysis of responses to question 2 (Do you suffer from a lack of natural light sources?) indicates that 31.6% strongly agreed, 1.8% agreed, 10.5% were neutral, 17.5% disagreed, and 38.6% strongly disagreed. The analysis of responses to question no 6 (Do you prefer to work in an open-plan office with eye contact with colleagues?) indicates that 12.3% strongly agreed, 15.8% agreed, 12.3% were neutral, 15.8% disagreed, and 43.9% strongly disagreed.

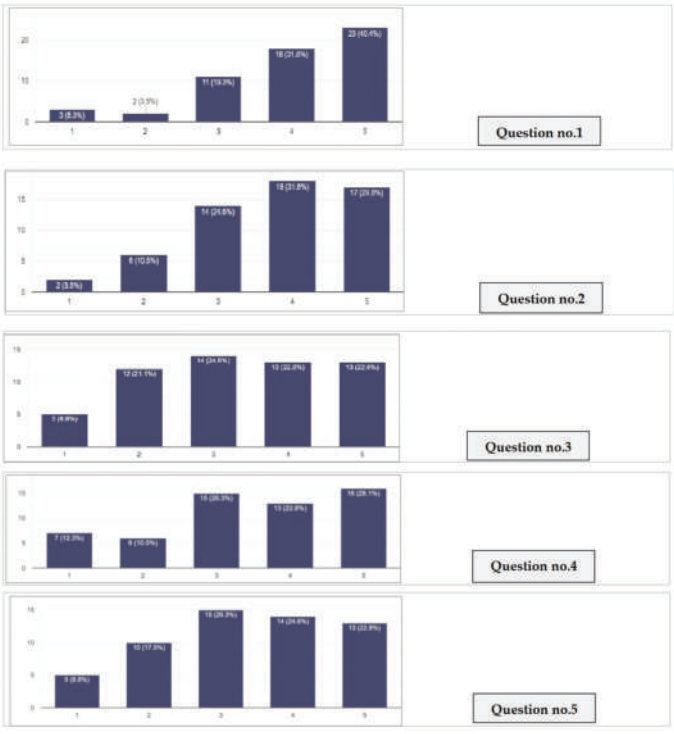


Figure 6. Analysis of responses to the second section.

Table 7. Frequency of responses to the third section on availability of natural and artificial lighting.

No	Third Section: Availability of Natural and Artificial Lighting Sources	SD	D	N	A	SA
1.	Is there a source of natural lighting in your office?	20	1	5	12	19
2.	Do you suffer from a lack of natural light sources?	22	10	6	1	18
3.	Is the current lighting for the office commensurate with the interior space?	6	4	8	18	21
4.	Do you prefer vertical partitions (walls) for the office to be solid?	6	6	5	14	26
5.	Does your office interior design make you feel private?	6	4	6	13	28
6.	Do you prefer to work in an open-plan office with eye contact with colleagues?	25	9	7	9	7

Statistical graphs of the data in Table 7 showing the analysis of responses to the third section are shown in Figure 7.

Table 8 shows the responses on materials and colors, which consists of five questions. The analysis of responses to question 2 (Do the materials used in the interior design elements (floors, walls, ceiling) for the office make you feel comfortable and functional?) indicates that 17.5% strongly agreed, 36.8% agreed, 21.1% were neutral, 14% disagreed, and 10.5% strongly disagreed. The analysis of responses to question 5 (Are the materials used in the office furniture items appropriate from your point of view?) indicates that 17.5% strongly agreed, 36.8% agreed, 24.6% were neutral, 8.8% disagreed, and 12.3% strongly

disagreed. The analysis of responses to question 3 (Are the colors used in a way that helps you feel comfortable and positive?) indicates that 14% strongly agreed, 38.6% agreed, 15.8% were neutral, 15.8% disagreed, and 15.8% strongly disagreed. The analysis of responses to question 4 (Does the distribution of colors in the office make you feel lethargic and lazy?) indicates that 14% strongly agreed, 7% agreed, 21.1% were neutral, 19.3% disagreed, and 38.6% strongly disagreed. The analysis of responses to question 1 (Do the colors used in the furniture items make you feel stressed?) indicates that 10.5% strongly agreed, 8.8% agreed, 14% were neutral, 24.6% disagreed, and 42.1% strongly disagreed.

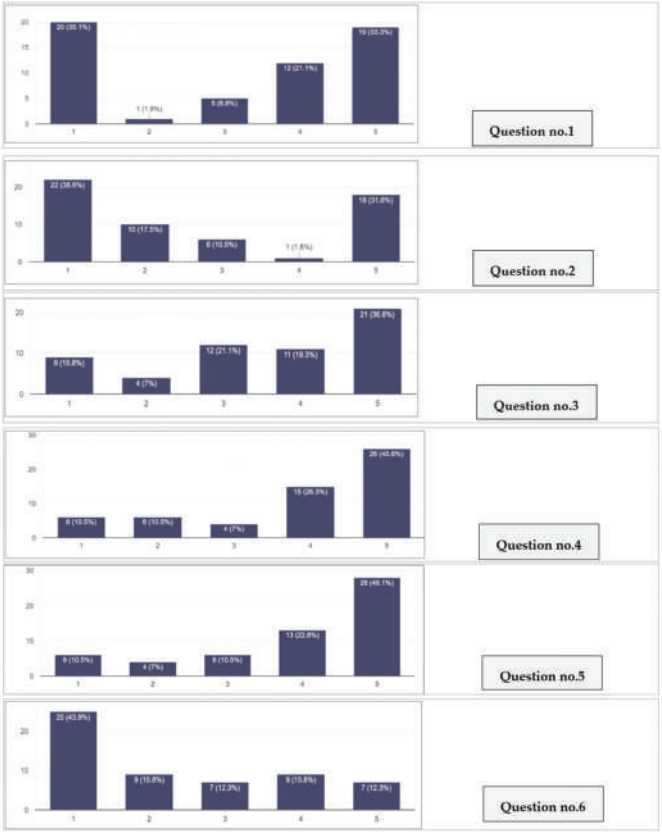


Figure 7. Analysis of responses to the third section.

Table 8. Frequency of responses to fourth section (materials, colors).

No	Fourth Section: Materials, Colors	SD	D	N	A	SA
1.	Do the colors used in the furniture items make you feel stressed?	24	14	8	5	6
2.	Do the materials used in the interior design elements (floors, walls, ceiling) for the office make you feel comfortable and functional?	6	8	12	21	10
3.	Are the colors used in a way that helps you feel comfortable and positive?	9	9	9	22	8
4.	Does the distribution of colors in the office make you feel lethargic and lazy?	22	11	21	4	8
5.	Are the materials used in the office furniture items appropriate from your point of view?	7	5	14	21	10

Statistical graphs of the data in Table 8 showing the analysis of responses to the fourth section are shown in Figure 8.

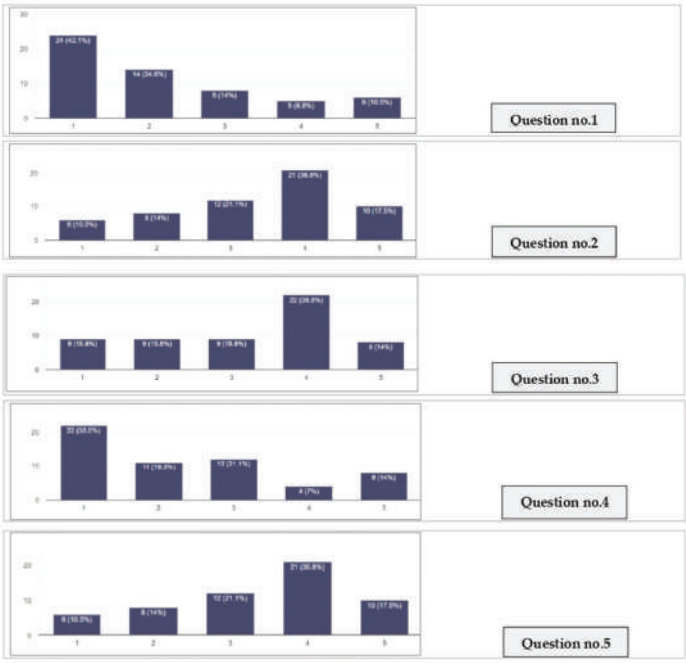


Figure 8. Analysis of responses to the fourth section.

The following are the results related to the third question: how can we help employees reach their highest levels of happiness and quality in the work environment?

The statistical analysis of the 57 responses to the questions in the fifth section of the questionnaire (Table 9), which consists of seven questions about resting places within the work environment, indicates that for question 1, 59.6% strongly agreed, 28.1% agreed, 7% were neutral, 1.8% disagreed, and 3.5% strongly disagreed. From this analysis, we can see the importance of providing time to take breaks from the daily workload within the institution.

Table 9. Frequency of responses to the fifth section (Rest areas within the work environment).

No	Fifth Section: Rest Areas within the Work Environment	SD	D	N	A	SA
1.	Do you feel that you need to take breaks during your daily work?	2	1	4	16	34
2.	Do you prefer to take time off alone?	8	7	11	13	18
3.	Would you rather take a break in your office (formal work area)?	12	13	9	7	16
4.	Would you rather take a break outside your office (formal work area)?	10	7	10	14	16
5.	Are there places to rest from work at your institution?	34	5	11	6	1
6.	Do you feel that having resting places at your institution is important?	1	3	5	6	42
7.	Does the presence of resting places in your institution help achieve job happiness and strengthen relationships between you and co-workers?	6	2	6	10	33

Figure 9 shows the analysis of responses to question 2, about spending time alone, indicates that 31.6% strongly agreed, 22.8% agreed, 19.3% were neutral, 12.3% disagreed, and 14% strongly disagreed. This shows that it was necessary to provide suitable places for rest individually or collectively according to the desires of the employees.

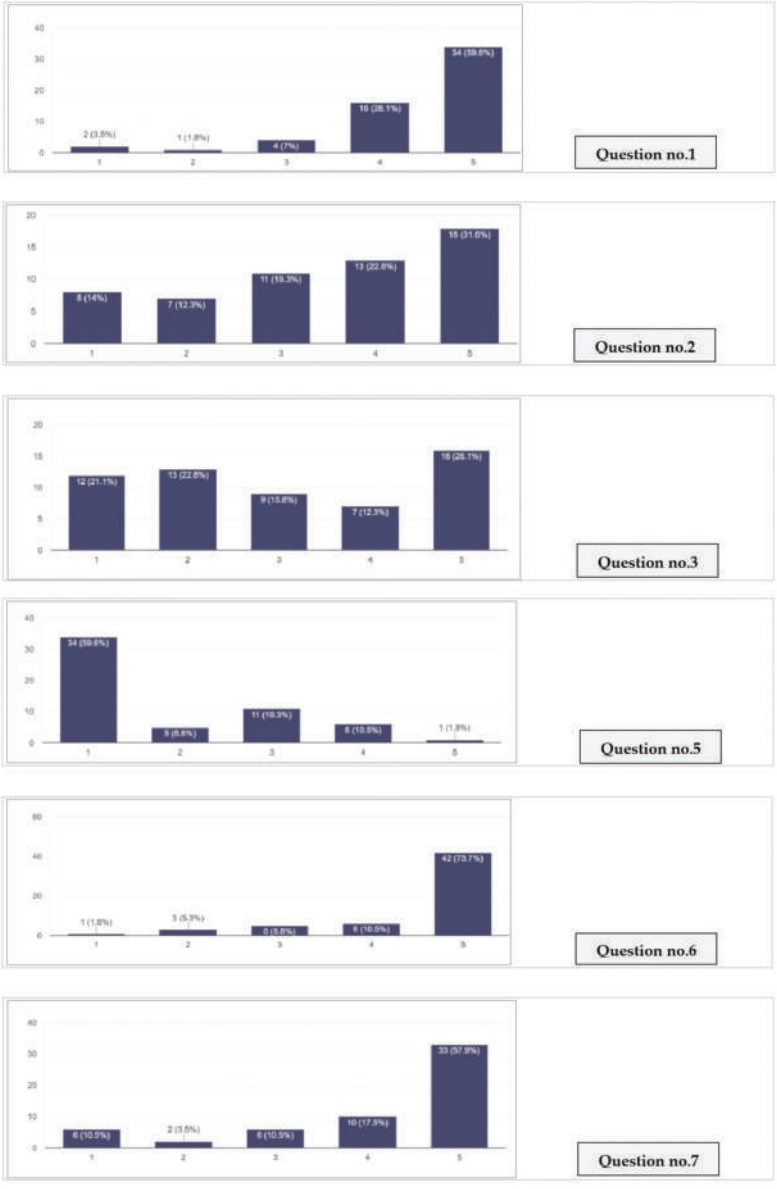


Figure 9. Analysis of responses to the fifth section.

The analysis of responses to question 3, about employees' desire to spend rest time in their offices (official workplaces), shows similar values: 28.1% strongly agreed, 12.3% agreed, 15.8% were neutral, 22.8% disagreed, and 21.1% strongly disagreed.

The analysis of responses to question 5, about the availability of resting places within the institution, shows that 1.8% strongly agreed, 10.5% agreed, 19.3% were neutral, 8.8%

disagreed, and 59.6% strongly disagreed. These percentages indicate that there were no resting places within the institution; thus, there needs to be development and modification in order to provide places to rest during work.

The analysis of responses to question 6 concerning the importance of having resting places at the institution indicate that 73.7% strongly agreed, 10.5% agreed, 8.8% were neutral, 5.3% disagreed, and 1.8% strongly disagreed. These percentages indicate the need to provide resting places and that they have an impact on employee comfort and happiness.

The analysis of responses to question 7, about the presence of resting places and their role in achieving job happiness, indicates that 57.9% strongly agreed, 17.5% agreed, 10.5% were neutral, 3.5% disagreed, and 10.5% strongly disagreed. The researcher believes that providing such spaces would help achieve happiness and quality in the institutional work environment.

The following are the results related to the fourth question: What are the future vision and proposed solutions to achieve functional and institutional happiness of the work environment?

The researcher presented suggestions about achieving job happiness in the institutional work environment to the questionnaire respondents, and their suggestions included the following:

- Provide an attractive and safe work environment in which the interior design elements are available while providing well-equipped rest areas with the appropriate furniture that facilitates creativity and innovation;
- Provide a comfortable work environment for King Faisal University employees that suits them and their preferences, as some prefer to be in a closed office where they can focus on work and avoid noise, while others prefer to work in an open-plan office that contributes to cooperation and visual and intellectual communication among the staff;
- Provide additional workspaces outside the offices that enable collaborative or individual work and generation of ideas while strengthening social bonds and exchanging opinions;
- Activate happiness days at the university and its faculties;
- Achieve job happiness through interior design treatments that are commensurate with the nature of the job and the space to improve motivation;
- Provide natural lighting sources within the institution for psychological comfort during work;
- Pay careful attention to the selection of colors that can help to spread positive and stimulating energy in the workplace;
- Provide the appropriate thermal climate in terms of heat and cold, which has an impact on the performance of workers and is reflected on their efficiency at work.

11. Recommendations

- Provide an internal work environment with an interior design that helps employees feel functional happiness;
- Improve employee productivity through air quality, lighting, and temperature, as these are among the factors that positively affect health and enhance performance in a comfortable work environment;
- Understand that innovation in interior design has a positive impact on the level of the work environment in general and motivates employees to work in particular;
- It is necessary to allow employees to get away from their computers; thus, they can have job comfort;
- Encourage researchers and interior architecture designers to put forward creative proposals to redesign the workplace to raise the level of happiness;
- Increase the interest of university-level institutions in the role of interior design in the work environment and to work on their wellbeing and make it a happy environment that stimulates activity, generates constructive energy, and stimulates positivity among employees;
- Provide safety and prevention standards in the work environment;

– Provide a positive and happy work environment that encourages positive communication among workers.

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Towards a Better Interior Design for the Academic Library at College of Education—King Faisal University

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Abstract: Academic libraries include college and university libraries. Interior design is an important way to bring about the required change in transforming academic libraries from a repository of books into places for research and communication. While interior design plays a major role in providing an innovative functional design in academic libraries within universities, the problem of the study lies in the importance of academic libraries and their main role in university education institutions in encouraging and supporting scientific research among students and faculty members. According to the role of interior design in designing academic libraries, the researcher finds that there are problems with interior design in the academic library at the College of Education. It needs to be re-designed to improve functionality and aesthetics and enhance the internal space for users to achieve effective use of the internal library space. The study aims to create a better design of interior environments in academic libraries in order to feature creativity and innovation. The research method is descriptive–analytical to describe and analyze the current interior design of the academic library at the College of Education at King Faisal University and collect real information about the library and the problems of interior design. Then, it was presented through the opinion poll tool to the beneficiaries to know their opinions about the current design of the library and to benefit from them in the design proposal of the academic library according to the correct design considerations. Then, the opinion poll tool was displayed again according to the design proposal to know the views of the beneficiaries again to contribute to providing an appropriate research environment for students and faculty members.

Keywords: interior design for libraries; library buildings; academic library; university libraries

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1. Introduction

The academic library is an integral part of the formal education system which provides time-bound education from primary school level to university level. An academic library works as a base for teaching, learning, research, etc.

In addition, it is an essential part of higher education institutions (universities, colleges, and institutes) and is one of the cultural institutions having an important scientific role in supporting curricula according to different disciplines and supporting research by undergraduates, graduate students, and faculty members; this role is no less important and necessary than any other role that can be played by any other scientific institution.

Academic libraries are an important part of their academic institution, and the vision, mission, and goals of the academic library are linked depending on their academic institution's mission, vision, and goals. The academic library is a basic supporter of the academic and research needs of faculty members and students [1].

Academic libraries are considered sources of knowledge and research that create opportunities for learning and research for students. It is necessary to know the needs of the users of academic libraries so that the academic library can provide these services efficiently to its users and increase users' satisfaction through quality management.

In addition, the design standards for academic libraries in higher education institutions are directed towards advancing their role in providing suitable places for learning

and research and achieving the university institution's missions. In addition, they are directed towards the continuous improvement in the internal space of libraries in design and functionality in proportion to their area to be suitable for students' study and learning as a common work and learning space [2]. The role of interior design in academic libraries is an important role by establishing proper planning for the internal departments of the library according to their functions through a functional and aesthetic design that fulfills the requirements of the internal space of the library and is commensurate with the requirements of the users, students, and faculty members. The interior design is based on the foundations of standards for designing academic libraries in universities; planning, designing, and renovating academic libraries involve many design criteria for the needs of users in the library. The development of the traditional design of the academic library starts with reshaping gathering, studying, and reading spaces into more collaborative and tech-enriched spaces by re-planning the reading and study seating units into a design conducive to collaborative learning. The design is the most important part of the academic library as it can affect the users; it must be attractive aesthetically, suitable, and functional to attract the patrons to come to the library. In addition to the flexibility, the library's interior design must be more suitable to be applied to the academic library nowadays due to the new technological discoveries.

When planning the academic library space, it should have a variety of spaces to suit all the diverse needs of students, as the needs of the individual student differ from the needs of groups according to some of the activities in which the students participate. Four different types of space must be planned within the academic library: spaces of collaboration, sanctuary, interaction, and community. These four spaces provide students with diverse environments that suit their needs during their different times.

2. Literature Review

There are many recent literature reviews in the field of academic library space design. This study will review several studies that have benefited from its most prominent features. The researcher would like to point out that the studies that will be reviewed came in the period between 2002 and 2018 and included several countries, which indicates their temporal and geographical diversity.

In the following, we present a presentation of these studies; then, we explain what the current study offers by identifying the difference between the current study from the previous studies; and finally, we explore the aspects of benefiting from previous studies in the current study.

Rizzo (2002) provides some useful tips for four types of spaces: highly active and engaging shared spaces; interactive, collaborative spaces for teamwork or individual work; quieter spaces such as reading and study rooms; and places for contemplation out of the way for quiet and deep thought. According to the researcher, a good and successful academic library design would be by achieving a design balance between these four types of internal spaces for the library and to be characterized by design flexibility according to the needs of users, whether at exam times or group collaboration spaces that suit a larger number of students while working on a group project [3].

Beard and Dale (2010) provide five categories of different user spaces based on researchers' observations of UK higher education institutional libraries. They are individual information gathering, group collaborative work in open space, silent individual study, small-group collaborative work, and teaching and structured learning. Each of the five categories is designed to support an educational focus. The researchers suggested that applying learning points from others innovatively and flexibly, keeping in mind its own needs, can be a good library design [4].

Cunningham (2012) provides a scheme useful in clarifying the needs of users to be taken into account in the design of the library space that architects can benefit from and use. This schema consists of four levels: the lowest level of the pyramid refers to access and connections (including location, zones, collection, information, and network), the next level

is used and activities (including reading, writing, collaborating, furniture, and tools), and the next level is sociability (which includes communal, social, quiet, noisy, independent, and group). The higher level of the pyramid refers to comfort and image (which includes the ambiance and sense of scholarship) indicates the highest-level attribute of comfort and feel for an ideal learning space [5].

Jochumsen et al. (2012) propose a four-space model that has been used in public libraries in Nordic countries. It provides the desired outcome of library spaces at a conceptual level. The four are inspiration space; learning space; meeting space, and performative space. "The four spaces are not to be seen as concrete 'rooms' in a physical sense, but rather as possibilities that can be fulfilled both in the physical library and in cyberspace. In an ideal library, these four spaces will support each other, and thereby support the library's objectives." According to the model, the library's overall objective is to support four goals: experience; involvement; empowerment, and innovation. These could also be overlapping functions that interact in the library space physically and virtually [6].

Narum (2013) presents a proposal consisting of four questions to be considered when designing future learning spaces. The first question is, what do we want learners to become? The second question is, what are the experiences for this to happen? The third question is, what are the spaces that enable these experiences? The fourth question, how do we know? The researcher suggested focusing on the idea of transformation so that it would be easier to see how investments in physical spaces made a difference in how students experience learning. These questions are not directly related to libraries but are closely related to the mission of academic libraries in supporting the design of learning and research spaces for learners [7].

Clugston (2013) provides the interior designer's perspective on the principles of new library design. The library's interior design should include flexible and multifunctional spaces that can be permanently rearranged to suit the different functions within the library ensuring efficient use of the interior space. The design of the spaces must also be commensurate with different learning styles and needs in addition to providing sufficient spaces that ensure comfort for learners and are commensurate with their numbers, providing them with cooperative and social spaces that suit the needs of learners, and providing information in clear and direct communication [8].

Ling, Fan, and Boya (2018) provide the importance of the role of physical academic library facilities and their internal impact on library space and readership attraction. Since academic libraries are part of higher education activities, researchers have empirically analyzed the importance of various library design features that help enhance student learning satisfaction. They found that the lighting environment, the acoustic environment, as well as the location of the library building were the main determinants that influenced the use of the university library by students in a major university in China, and they made their suggestions for modifying the design of the university library: a library to suit the educational needs of students, rebuilding the standing and function of university libraries in the age of digital information and transforming them from a provider of reference material into actual spaces for learning on campus [9].

McCabe, JP (2003) stresses the importance of studying the psychological effects of color. Additionally, what is caused by dark colors and bright colors, and emphasizes the necessity of adopting a contemporary approach in choosing the colors and materials used in the design of libraries to create an attractive, friendly, and stimulating image for the beneficiaries. Colors should be combined selectively and based on a neutral background, color may appear on elements such as selected walls and partitions, and the choice of fabric for furniture, colors, and finishes should be appropriately chosen to enhance the attractiveness of the spaces for the specific age group of the user while harmonizing seamlessly with the overall concept of the space as an attractive and stimulating place to visit [10].

By reviewing literature reviews, we note that the current study agrees with previous studies on the main topic and its general objective is that it differs from it in several aspects that this study seeks to address, namely:

- The research problem included the actual reality of the interior design of the academic library at the College of Education at King Faisal University from the point of view of the beneficiaries of the faculty members and students.
- This study used the descriptive-analytical method in collecting real information about the library and the problems of the interior design of its interior space.
- An opinion poll tool was used by one sample of faculty and students to collect accurate information and opinions about the current interior design of the library from the point of view of the beneficiaries to know their opinions and needs to take them into account and to benefit from them in the development of and improvement in the academic library.
- The researcher presented a proposal for the modern interior design of the academic library that is designed by the needs of the beneficiaries and fits with the requirements of the times while solving the design problems existing in the current design and benefiting from the views of the beneficiaries to meet their needs and aspirations.
- The researcher used the second opinion poll tool for the same sample of faculty members to view the interior design proposed by the researcher for the academic library to reveal their opinions and responses.
- The researcher benefited from previous studies on the points related to the design standards of libraries and the instructions for dividing the internal spaces in the library to achieve the effective use of the internal space and design flexibility according to the levels of the beneficiaries' needs and their internal activities that must be taken into account in the design of the library space.

3. Problem Statement

The problem of the study lies in the importance of academic libraries and their main role in university education institutions in encouraging and supporting scientific research among students and faculty members. According to the role of interior design in designing academic libraries, the researcher finds that there are problems with interior design in the academic library at the College of Education at King Faisal University. It needs to be re-designed to improve functionality and aesthetics and enhance the internal space for users to achieve effective use of the internal library space.

Design problems of the current interior design of the academic library:

The researcher will display a set of current pictures of the academic library that illustrate the design problems in it shown in Table 1.

Table 1. The problems of interior design in the academic library.

No.	Problems	Figures
1.	-The need for more items of furniture and interior equipment, such as reception desk, shelves, and computers, according to the number of users and internal departments. -The internal lighting is not commensurate with the library space, which affects the efficiency of the internal use of the library by users.	

Table 1. *Cont.*

No.	Problems	Figures
2.	-Failure to exploit the internal space of the library with the optimal distribution of used furniture units and their diversity in proportion to the internal activities.	
3.	-The current interior design of the academic library is not an attractive learning environment for students. -The dimensions of the used book storage units are not suitable as they are huge and have great depth and were not used in an optimal functional way.	
4.	-The internal space of the academic library, in its current form, does not fit design and functionality with the needs of the beneficiaries. -The furniture used is heavy and not flexible or easy to move.	
5.	-The use of heavyweight wooden partitions in the internal division affects the narrowness of the internal space and the movement paths according to the services provided within the library.	
6.	-The lack of proportional wooden vertical dividers in dividing the interior spaces of the library functionally and aesthetically.	
7.	-There is no visual contact between users or a sense of familiarity due to the solid wood vertical partitions.	

4. Study Objectives

The current study aims to develop the interior design of the academic library at the College of Education at King Faisal University to support its main objectives, which are:

- The research aims to provide the needs of users within the academic library as places for collections and places for reading, discussions, learning, and research.
- Providing a stimulating interior design environment for graduate students, faculty members, or undergraduates for scientific research.
- Achieving the design standards of the academic library functionally and aesthetically to achieve the functional requirements.
- Providing research educational resources for graduate students, faculty members, or undergraduates.

5. The Importance of Study

- The importance of the study is due to the importance of the topic it raises about academic libraries and their role in encouraging and supporting scientific research among students and faculty members.
- Academic libraries are the center of academic activities, providing many services to their students and faculty members to facilitate the teaching, learning, and research process.
- Providing a modern and comprehensive set of information sources that are closely related to the academic curricula, academic programs, and scientific research conducted at the university.
- Efficient interior design plays a major role in the design of the library's interior space and has a significant role in the efficient use of the library by users.

6. Study Limits

- Time Limits: The second semester of the academic year 2021–2022.
- Human limits: Faculty members, undergraduate, and graduate students of King Faisal University.
- Spatial Limits: Academic Library College of Education at King Faisal University.
- Subject Limits: Developing the interior design of the academic library at the College of Education in student departments at King Faisal University to support its main objectives of providing an appropriate and effective research environment for users.

7. Study Questions

The research seeks to answer the following research questions:

- What are the necessary design standards for designing academic libraries in universities?
- What is the reality of the academic library at the College of Education at King Faisal University in the shade of the design standards that need to be developed?
- What is the proposed vision for designing a better interior environment in the academic library at the College of Education at King Faisal University in light of the necessary design standards?

8. Materials and Methods

The research process was based on the descriptive-analytical approach, and the relevant literature was presented, and the description of the interior design of the academic library at the College of Education, King Faisal University, in which the study was conducted, was presented, and real information was collected about the library and its interior design problems, and used in the application of the correct design, followed by the proposal for the design by the researcher for the academic library, which he hopes will contribute to providing a suitable research environment for students and faculty members by the standards of the interior design of the academic library to achieve efficient internal use and create a friendly place for library users.

8.1. Study Tool

- The researcher used an opinion poll tool consisting of 22 questions directed to the beneficiaries of the faculty members and students about the current interior design of the academic library to reveal the opinions and needs of the users. The response of the beneficiaries on the card is (yes or no) to a sample (consisting of 67 users of faculty members and students).
- Then, this tool (an opinion poll) was distributed again to the beneficiaries to know their opinions about the design proposal for the academic library submitted by the researcher so that the beneficiaries' response to the card would be (yes or no) and the sample consisted of 67 users of faculty members and students.

8.2. Types of Libraries

There are four major categories of libraries as Figure 1:

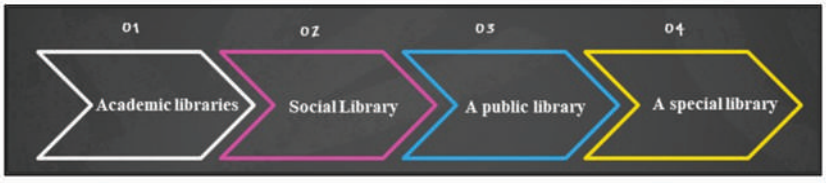

Figure 1. The diagram shows the types of libraries.

- Academic libraries:

The academic library is part of the politics, part of the culture, and part of the response of its parent institution; whatever affects higher education, affects academic libraries [6]. Academic libraries are the libraries that are located in universities, colleges, and institutes and are characterized by their important role in supporting their affiliated institution to meet educational needs and support studies at the undergraduate and graduate levels by supporting curricula, scientific research, and research by faculty members and students at the university [11].

Components of the academic library space:

- Lecture halls.
- Collaborative learning and meetings.
- User seating units.
- Workstation spaces.
- Viewing and listening rooms [12].

Modern Academic Libraries:

In the twenty-first century, academic libraries are in a technological transformation from what they were before, where information, scientific resources, and books are accessed digitally via the internet, containing books, references, e-books, seating units for collaborative or individual learning, and meetings [13].

- Social Library:

This type of library has an essential role in society, as libraries are a source of knowledge and culture in addition to the services provided by the library, as it opens the way for learning and helps in eradicating illiteracy and education in addition to helping to form ideas through reading and perusal, which enhances the progress of society culturally, scientifically, and creatively.

- Public Library:

This is a library that is available for all people and is considered a local gateway to knowledge that contributes to the cultural development of the person and social groups [14].

- Special Library:

A special library is a library that specializes in providing information sources on a specific topic, meaning that it serves a targeted group of users and helps specialists in providing the services they need. Examples of private libraries (are corporate libraries, government libraries, medical libraries and others) [15].

Types of Academic Libraries as Figure 2 [16].

Figure 2. The diagram shows the types of academic libraries.

Main places of the Academic Library:

- The main reading room:

This is a vital and very important area in terms of movement and activity, and its area is determined by the number of visitors, and the following conditions are required: that it be in the heart of the library, that it be close to the area of the book galleries and have a direct relationship with it, provided with good lighting suitable for reading.

- The circulation section:

The circulation section is a section attached to the main reading section that contains books, references, letters, and other educational materials organized in a way that allows and helps to control the process of borrowing and retrieval in an orderly and accurate manner.

- Department of Scientific Journals:

This section is considered one of the important and main sections in the libraries, on which the library depends mainly to respond in meet the continuous needs in providing information and modern research resources in the field of specialization for researchers and scholars.

- Retreats:

These are separate rooms equipped with cupboards and shelves for books and references. They also contain cupboards belonging to the researchers to keep their papers. The spacers between these rooms should be made of sound-insulated glass (transparent dividers) to provide natural light with an artificial light source as well as furniture items suitable for each room. These rooms are supported by auxiliary rooms such as photocopying, printing, and computers.

- Library Management:

The library management is considered the main body responsible for the library by performing the various functions according to the internal departments, and its interior design must be commensurate with the work volume and the number of employees [17].

9. Discussion

- The results related to the first question:
- What are the necessary design standards for designing academic libraries in universities?

To answer this question, the researcher presented the design and planning considerations for academic libraries that should be taken into consideration when designing, planning, and developing academic libraries.

Planning considerations of the academic library:

There are scientific terms related to the description, planning, and design of the academic library, such as Figure 3.

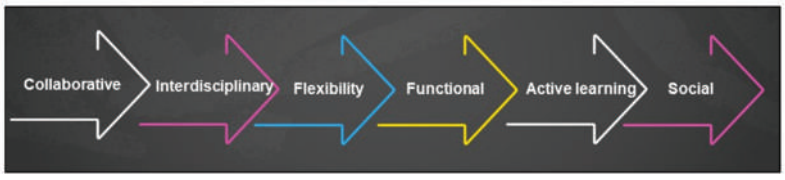

Figure 3. The diagram shows scientific terms for planning and design of the academic library.

- The layout and interior design of the library should be commensurate with its nature, functional sections, the number of visitors, and their needs.
- The academic library should be designed on a functional basis.
- The need to focus on the effective interior design of the spaces designated for students and faculty users to support learning and provide for their needs.
- The main study and reading areas should be close to the bookshelves.
- The interior design of the academic library must be able to expand and develop in the future [18].
- The physical space plays an important role in helping the academic library meet the needs of users. The movement paths that link the departments and some of them must be taken into account to help in accommodating a large number of students and faculty members through the library space daily.
- The designer should facilitate entry and exit and eliminate congestion and conflict in the movement paths between visitors and employees by allocating a special entrance to the administration.
- All the major factors that affect the use of academic library space must be taken into account.
- Providing technological services that the academic library should provide to its students and users, ideal places to provide computers and other information technology.
- Achieving calm in the library through the use of tightly closed windows, which provide sufficient calm.

The attributes of the Modern Academic Library:

- Full of natural light.
- Shelves are easy to reach.
- Technology is accessible to patrons and visible to staff.
- Possibility to sit for cooperation and independent work.
- Seating for collaboration and independent work.
- Distinct zones for different uses [19].

Academic Library Lighting Standards:

Natural lighting:

This is the lighting that comes from the sun, and its amount in the interior space depends on the number and area of wall openings such as windows and skylights. It is physiologically most appropriate for humans, but it changes and varies with time and season. The natural lighting provides visual and psychological comfort for humans and helps with activity and vitality. Natural lighting is the best in academic libraries, as it is an essential component of architecture and light is one of the most important elements of interior design. Relying on modern technologies, engineers have tried to control the harmful part of the sun's rays and use its heat. Natural daylight helps reduce energy consumption and can be a source of glare, so adjustable window coverings should be provided to allow direct sunlight into the reading areas.

Artificial Lighting:

This is the illumination received from electric lamps, and it is based on three main ways to illuminate the space:

- General lighting: This is the lighting homogeneously used throughout the library.

- Thematic lighting: This is lighting certain areas of the internal space of the library to help illuminate certain sections and functions.
- Focused lighting: This is a type of objective lighting that focuses on specific functions in the library [20].

The internal environment of libraries contains various elements, the most important of which is lighting, because most of the activities that take place in libraries are directly related to sight. The quality of the internal environment of the library depends on the quality of lighting and space adequacy in addition to its layout and the quality and diversity of furniture.

In addition, the process of providing appropriate lighting for reading and work halls depends on the proper use of natural and artificial lighting, simultaneous use, or each one alone, according to what the need requires. Reading and searching are very important in libraries. It requires the provision of good lighting which is appropriate aesthetically and functionally for the success of the library's interior design in general. The tasks within the library depend mainly on high-quality lighting, as technology has introduced new and advanced types of lighting requirements, as it affects the interior design of the library significantly and can also improve its efficiency.

- Bookcases should be provided with adequate lighting so that users can access references and books simply and without visual disturbance.
- The general lighting design of the library should be suitable for many activities.
- Artificial lighting is used in case of insufficient natural lighting using fluorescent lamps, and the lighting from electric lamps must be indirect so as not to cause luster.
- Plastic paper curtains were used for the windows to block direct sunlight.

Challenges with Academic Libraries:

- Noise:

Noise in libraries, in general, is a constant concern for library users, students, faculty, and administrators. It is one of the common problems, and by using some solutions such as installing sound insulation techniques, noise can be controlled and modified. [21]

- Power and capacity outlets:

This is possessing sufficient "strength". Having sufficient power is required for beneficiaries to charge their devices. Spaces without sufficient power for the users result in them being underused by the students.

- Sharing space with learning partners:

Allocate space for learning partners on campus. Some of these partners required more space than initially anticipated.

- Technology and its impact:

Patrons come to the library to use a variety of modern technologies. Technology provides a tool for academic library services. It also works on shaping and defining how services are provided to beneficiaries.

- The results related to the second question:
- What is the reality of the academic library at the College of Education at King Faisal University in the shade of the design standards that need to be developed?

To answer this question, the researcher used an opinion poll tool by designing a card consisting of 22 questions directed to the beneficiaries of the faculty and students about the current interior design of the academic library to reveal their opinions and needs through their responses to an opinion poll, and 67 responded shown in Figure 4, and as shown in Table A1; two were excluded because they were not valid.

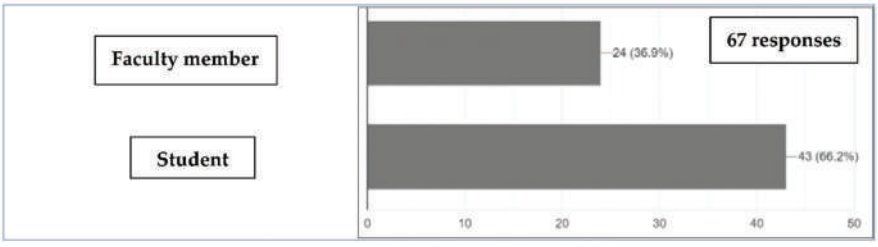

Figure 4. The distribution of the sample between the responses of faculty members and students.

Opinion poll result:

From the previous figure, we find that the sample consists of 67 beneficiaries, of whom 24 are faculty members (36.9%) and 43 are students (66.2%). Two were excluded because they were not valid.

From Table A1, it is clear that 87.7% of the beneficiaries' responses emphasized the role of the interior design of academic libraries in providing an attractive and effective learning environment for the beneficiaries, and 83.1% emphasized the importance of developing the current interior design of the academic library by developing furniture items for the different needs of cooperative and individual education, and reaching a design atmosphere that achieves visual comfort, as the current interior space of the academic library does not fit the design and functionality with the needs of the beneficiaries. A total of 80% of responses confirmed that the interior design of the library does not fit the requirements of the times and 73.8% responded that the floor plan of the library was not properly planned. In addition, 76.9% confirm that the current interior design does not achieve visual coherence and a sense of familiarity.

In addition, the distribution of book and reference storage units is not proportional to the library space, as it is concentrated in some aspects, causing narrow movement paths in some parts and widening in other parts. A total of 86.2% of beneficiaries expressed their opinion in changing the colors used. They also confirmed the lack of equipment for electronic search sources by 83.1%, and 81.5% would like to remove the vertical wooden dividers used to divide the internal spaces of the library, which affects the narrowness of space and the feeling of lack of visual communication between the beneficiaries. Some of the views of the beneficiaries were that the current internal environment of the academic library provides for the different needs of cooperative or individual education by 40%.

The proposed design of the Academic Library of the College of Education—King Faisal University.

Academic library shape

When determining the basic shape of the academic library at the College of Education, we find that its shape is square, whereas library engineers and consultants agree that the most functional form of the library is the square or a series of squares. Architects sometimes see the square shape as too simple and uninteresting: however, long, narrow spaces and round rooms do not allow for effective planning of shelving ranges or good visual control by staff. The square shape is also easy to divide and rearrange regardless of whether the library is large or small. Successful academic library design relies on large, flexible spaces that can be easily rearranged as the needs of the library change from time to time; shelving and book storage must be planned to accommodate them [22].

Library Zoning:

The primary goal of effective library design and space planning is that the facility must respond to the needs of students and faculty members. The floor plan of the library shows its interior design through the distribution of the different functional sections and their relationship to each other with a study of the internal movement paths between the functional sections as Figure 5.

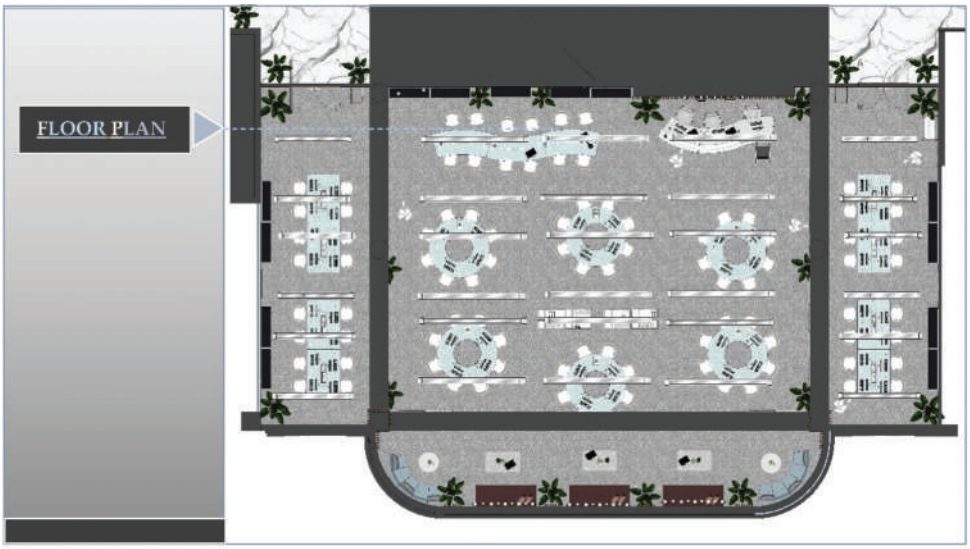

Figure 5. Floor plan of the academic library.

The proposed floor plan of the academic library:

The layout of the floor plan of the library space comes in all shapes and sizes, and the primary goal of effective library interior design and space planning is that an academic library should provide design and functional requirements of users and respond to the needs of its students and faculty while defining the interior departments, their spaces, and their needs [23].

Library equipment

This term includes roughly the items and vocabulary of library furniture from seating units, tables, storage units, and shelves for books and references, supplies, and tools with which the library operates as Figure 6 [24].

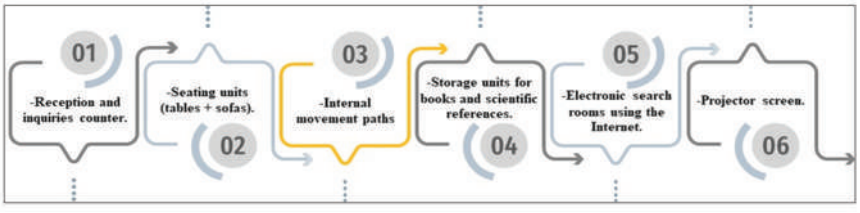

Figure 6. The diagram shows the components of the academic library.

It consists of:

1. Reception and inquiries counter.
2. Seating units (tables + sofas).
3. Internal movement paths.
4. Storage units for books and scientific references.
5. Electronic search rooms using the internet.
6. Projector screen.

Internal Perspective of the Library as Figure 7.

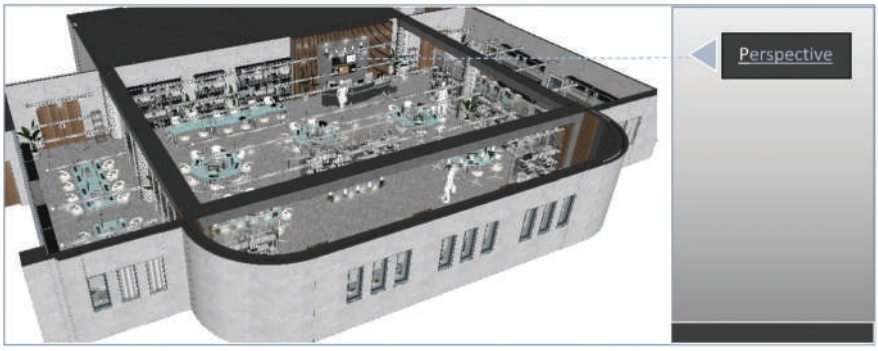

Figure 7. The perspective of the academic library.

Design of Reception Desk:

The proposed interior design of the academic library of the College of Education at King Faisal University as Figure 8. provides quiet and conducive areas for study as well as common areas for university study and collaboration and provides reading areas, discussion areas, learning, and research areas, and facilities for accessing electronic resources. The proposed finishes were carefully shaped, and there was a conscious decision to continue coordinating the interior design elements, the various furniture elements, the materials used, and the colors suggested in the design. Bookcases are designed as a different combination of shelves that allows users to store and display books in a smooth and easily accessible way as well as computer desks, tables, and chairs to get the right balance in distributing different furniture items according to functional requirements and according to capacity for different activities. It also designed integrated spaces for student discussions and presentations, providing spaces designed for small group meetings as Figure 9.

Figure 8. The proposed space for the design of the reception space in the library.

Figure 9. The perspective of reception and inquiries counter.

The reception must be directly connected to the entrance with its connection to the library's internal monitoring network as Figure 10; it is wide enough and the largest number of students passing at any time is counted. The reception counter as Figure 11. is designed to inquire about data, books, or references needed by researchers, as well as for external or internal borrowing. It is designed to suit everyone in addition to people with special needs. The back of the information counter is designed with a cladding of wooden slats, 3.5 m high and 6 m wide to cover the back of the counter.

Figure 10. Internal perspective shows reception and seating units.

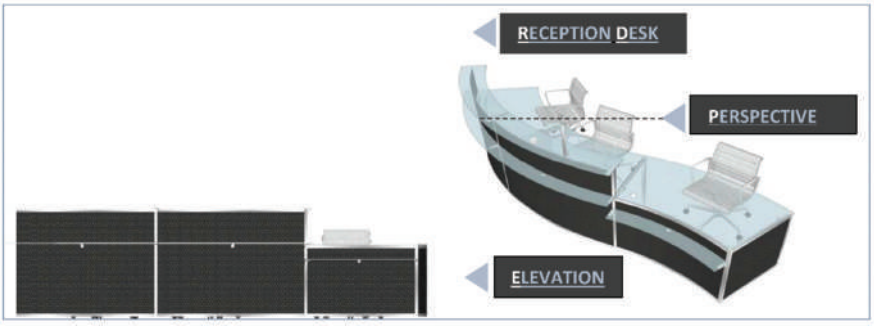

Figure 11. Reception desk design.

The proposed new colors in the design.

The colors of the academic library trended to neutral tones to create a mobile library to view, research, and learn, in addition to the possibility of clarity of architectural details.

The appropriate light gray color for the walls was chosen, with the use of neutral colors in the interior space, and white color in the chairs, and burgundy color in the seating units (sofas); it is also preferable to use warm colors in the reading space. The columns are clad with straight brown wooden ribs with a dark gray color for the carpet of the library flooring instead of the dark blue color. Transparent glass partitions were used to divide the interior spaces according to the design instead of opaque wooden partitions, which caused the narrowness of the interior space and the inefficiency of lighting, the failure to achieve visual communication and a feeling of spaciousness, and the expansion of the library space.

Digital Resource Department:

Digital Resource Department: This section is mainly responsible for offering computer-based library services. It has 32 computers for the library students and faculty members. The use of computers throughout the academic library needs to be planned in the library's structure and systems simultaneously with the interior design to ensure continued energy savings at computer locations as Figures 12 and 13.

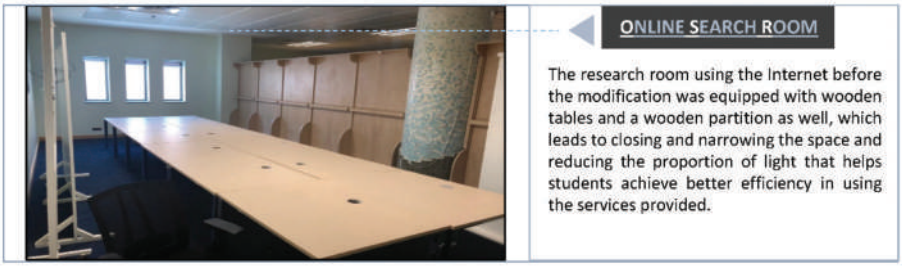

Figure 12. Internal perspective of an online search room before modification.

Figure 13. Internal perspective of an online search room suitable for 16 researchers.

The space was re-designed as Figure 14. by changing the furniture to modern furniture (glass tables equipped with computers and internet networks) with the replacement of the wooden partition with a glass partition that helps privacy in addition to achieving the internal visual connection to the library while allowing interior lighting and linking the functional spaces to each other and adding some storage units for books or tools for users. A glass partition that was installed in place of the wooden partition, with dimensions of 5.65 cm in width and 2.65 cm in height, was placed to separate the space for searching online and borrowing books and reading them. It achieves transparency and privacy for researchers. The glass partitions are considered a demountable wall so the spaces can be reconfigured over time. The concept of transparency is an approach to showcasing learning activities taking place in the academic library through open concepts, technology, and furnishings, and limiting physical barriers that might otherwise obstruct a user's open view.

Figure 14. The internal perspective of an online search room consists of two glass tables.

Standards for selecting Academic Library Furniture

Academic libraries have very particular requirements that all their furnishings must meet. The selection and arrangement of furniture within the library is an important issue

that needs to consider the human factors that influence how people interact within the environment. It is also relevant in the interior design of the library which demonstrates the concept of acceptable personal space to feel comfortable, through how close people are to sitting or standing next to each other. There are a few important factors to consider whenever you are designing furniture items for an academic library. Reading desks and tables are the important components of library furniture. Library furniture consists of many types of racks to display all kinds of books that students could pick and read themselves. It is necessary to know the appropriate standards for choosing furniture in the academic library. The furniture must be stable and durable, characterized by efficiency, comfort, and resistance, and made of good materials; furniture and design play a huge role in determining how students interact with a library through the following:

1. The design concept is based on balancing the needs of the users, students, and faculty members, and the ability to make the most of the designed space.
2. The interior design of academic libraries should provide an appropriate study for all internal functional departments in an innovative conception that helps in the effective use of the library.
3. Appropriate furniture in the library can make a huge difference to the attractiveness and functionality of library spaces.
4. The durability and reusability of furniture items.
5. The furniture item contributes to creating a balanced environment.
6. The need for natural light and artificial light to ensure that the area is properly lit, thereby avoiding eye strain [25].

Flooring:

High-efficiency materials have been used for permanent use, and floors can be covered with insulating materials such as carpets and rugs to reduce noise by absorbing sound in reading spaces.

Search and Reading Hall:

Reading hall standards:

- It should be in the heart of the library as Figure 15.
- It should be in the quietest area of the library.
- It is preferable to take into account the entry of natural light.
- Preferably near the entrance.
- The paths of movement must not conflict.

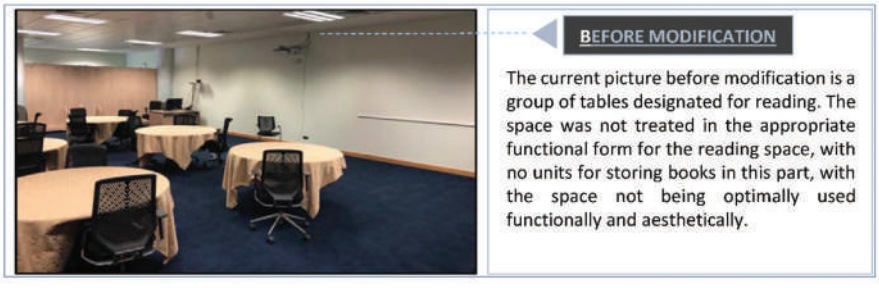

Figure 15. The interior design of the reading space before modification.

The reading and borrowing space have been modified by removing the wooden divider and adding storage units for books with a modern design that matches the interior design and used furniture pieces as Figure 16. In addition to providing the reading part with rectangular glass tables, the distribution of internal lighting was taken into account, which achieves comfort for users as Figures 17 and 18.

Figure 16. The interior design of the reading space contains modern glass tables and storage units for books and internal borrowing.

Figure 17. The interior design of the reading hall space contains tables and computers for online search and storage units for books and internal borrowing.

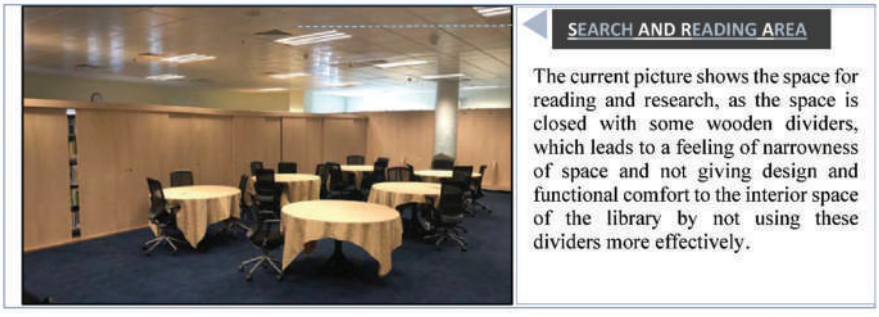

Figure 18. Shows the space for reading and research.

Library Bookcases:

Library bookcases are a great addition to any working environment, providing storage and display space while helping to keep your workspaces clean, tidy, and organized.

There are some considerations in distributing them within the library:

- The dimensions of the aisles between the shelves should be considered, which should reach 85 cm in libraries that many users come to. The shelves were distributed in the center of the hall to avoid the sun's rays and surrounded the reading areas where the shelves are divided according to the topics.
- It should be taken into account that the maximum height of the bookshelves is 175 cm.
- The bookcase units in this form were distributed in the parts of the library, where they were placed in the middle of the library hall according to the design standards of libraries. They were also attached to the glass partitions and shelves were placed in

front and behind the glass partition to become double shelves and were distributed numerically in proportion to the internal dimensions of the library as Figures 19 and 20. providing book storage and scientific resources according to the different disciplines and internal departments of the library.

Figure 19. The interior design shows the glass partition, book storage units, and interior paths.

Figure 20. Storage units for books.

Providing appropriate furniture in the interior space of an academic library makes a difference in the attractiveness and function of academic library spaces. This in turn increases the attraction for students to use the spaces more fully; a variety of seating units that help support teamwork is therefore essential in designing an effective collaborative seating space. Various seating and work surfaces must be adapted to meet the needs of different group activities and be appropriate to the size of the group with technical support as Figures 21 and 22 [26].

Figure 21. The current picture shows the space for reading and borrowing.

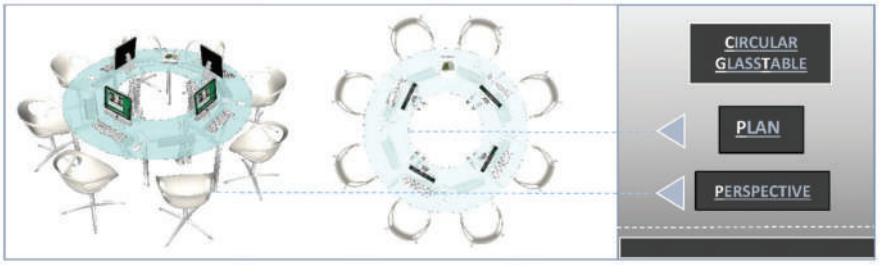

Figure 22. The library contains 6 modern glass circular tables, each table accommodates 8 people, and the total number of round tables accommodates 48 people.

Library Break Areas:

Seating space is an essential element in the design of the academic library. The library should have a variety of seating units such as benches, reading benches, and reading tables to choose from around the approach to learning. The reading area in the design model proposed for the academic library is also carefully designed so that the visitor can choose an individual reading area or a common area [27].

Figure 23 shows the proposed design of break areas, where the seating units were designed as contemporary furniture to allow users to sit and read or study in a quiet atmosphere that enjoys privacy, in addition to providing a shared social space, and allowing students to spend time away from desks. The book storage units were re-placed in a better design. The walls were also designed with some wooden cladding. In addition to providing natural light through windows, effective use of daylight can reduce energy consumption as Figure 24. The library is not only the nerve center of academic learning but also a good place to spend one's leisure time. Plastic paper blinds were used for the openings to block direct sunlight.

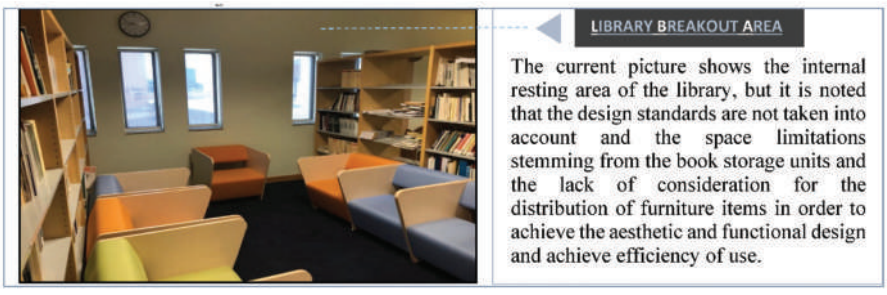

Figure 23. Shows the internal resting area of the library.

Figure 24. The picture shows the proposed design of break areas.

Movement paths within the library:

Internal movement paths in academic library design relate to three paths of movement.

1—Reader movement:

Which is considered one of the most important movements within the library and must be connected to all services without any complexity.

2—Staff movement:

Since the administration is one of the most important spaces within the library, and also because the employee provides the services required for readers.

3—The movement of books, references, and various services of the library:

It must be a hidden movement, that is, none of the visitors feel it, and it usually has a back entrance [28].

- The results related to the third question:
- What is the proposed vision for designing a better interior environment in the academic library at the College of Education at King Faisal University in light of the necessary design standards?

To answer this question, the researcher distributed this tool (opinion poll) consisting of 22 questions again to the beneficiaries to reveal their opinions about the design proposal of the academic library of the researcher, and 65 responded, as shown in Table A2.

Opinion poll result:

From the previous figure, we find that the sample consists of 67 beneficiaries, of whom 24 are faculty members (35.8%) and 43 are students (64.2%) as Figure 25.

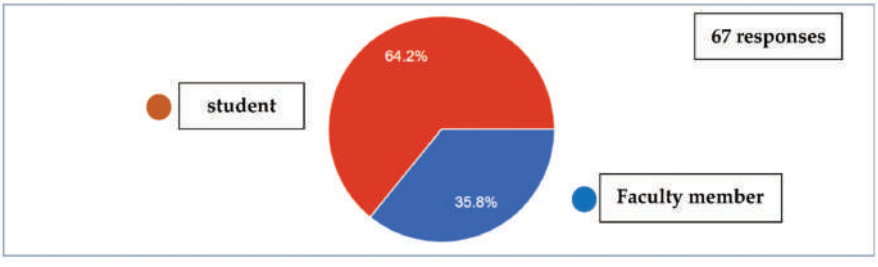

Figure 25. The distribution of the sample between the responses of faculty members and students.

The proposed design of the academic library was discussed by presenting it to the beneficiaries of the faculty and students, which was well received and satisfied through their opinions on the opinion poll. This is evident in Table A2. By analyzing the opinion poll of the beneficiaries' responses about the proposed design of the academic library from the researcher, where 67 beneficiaries responded, we find that there is general satisfaction with the new proposed design of the library, and many questions were approved by 100%, which was in response to the views and aspirations of the beneficiaries from faculty members and students on the development of the interior design of the academic library in line with the requirements of the times and their needs, and the modification of the floor plan design and functionality to achieve the efficiency of internal use, which has a positive impact on the beneficiaries.

In addition to providing the library with various and appropriate items of furnishing and interior fixtures, the efficient use of natural and artificial lighting be considered was taken into account. Some opinions, which constitute a small percentage of 9%, were about the inappropriateness of the color scheme in helping to feel energetic and the desire to learn.

Project Description:

The developmental design proposal of the academic library of the College of Education in the student departments at King Faisal University is an important objective that aims to develop the interior design of the library through a modern and innovative design vision commensurate with the nature of the interior space and its requirements, in addition to

the internal space of the library and how to design it with the most appropriate design solutions, including the realization of services and departments. It should be available in the library to achieve the aesthetic and functional aspect. This is reflected in the actual performance of students and faculty members in general and all library visitors from faculty to university members as Figure 26.

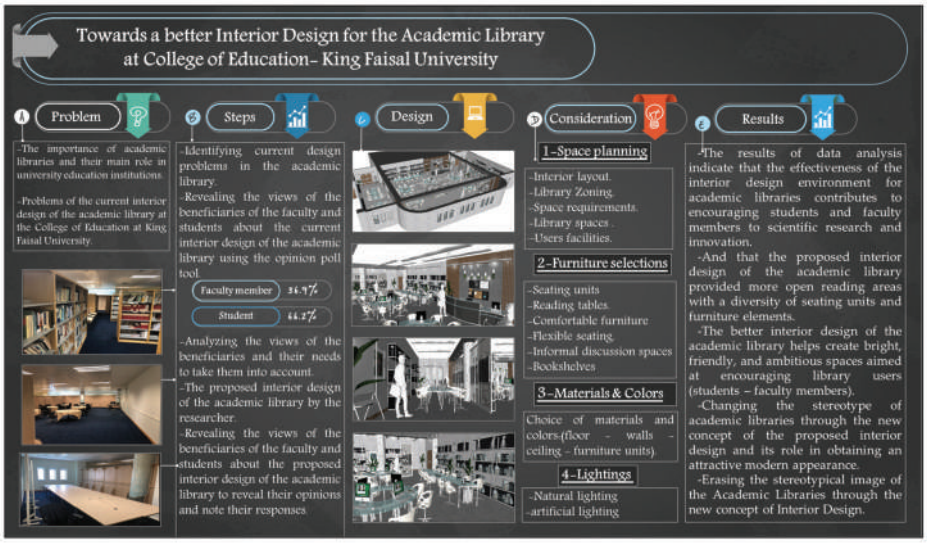

Figure 26. The framework explains the steps of the research.

10. Conclusions

- The results of data analysis in Table A2 indicate that the effectiveness of the interior design environment for academic libraries contributes to encouraging students and faculty members towards scientific research and innovation.
- Additionally, they indicate that the proposed interior design of the academic library provided more open reading areas with a diversity of seating units and furniture elements.
- The better interior design of the academic library helps create bright, friendly, and ambitious spaces aimed at encouraging library users (students and faculty members).
- The design helps in changing the stereotype of academic libraries through the new concept of the proposed interior design and its role in obtaining an attractive modern appearance.
- The design helps to show the important role of interior designers to create attractive and appropriate academic libraries.
- We erased the stereotypical image of academic libraries through the new concept of interior design.

11. Recommendations

- Libraries are good homes for introducing and providing new and experimental technology to students by designing the interior functional spaces that require providing the technology that students need.
- The interior design must be designed to accommodate the academic needs of users.
- The need to pay attention to the design of internal interaction spaces where library users interact with the resources and services provided.
- The necessity of applying modern technology in the interior design of academic libraries to reach more effective and efficient use spaces.

- The need to continuously poll stakeholders about the problems and challenges facing them in the ability to continuously improve, by interviewing the users and conducting questionnaires.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Objective: Information gathering about the current interior design of the Academic Library.

Description: The results of the responses of the sample of the faculty members and students in an opinion poll tool consisting of 22 questions about the current interior design of the academic library, College of Education, King Faisal University to reveal their opinions and needs.

Table A1. Opinion poll on the current interior design of the Academic Library, College of Education, King Faisal University from the point of view of the beneficiaries.

No.	Questions	Yes	No
1.	-Does the interior design of academic libraries have a major role in providing an attractive and effective learning environment for the beneficiaries?	57	8
2.	-Is the interior design of the library commensurate with the requirements of the times?	13	52
3.	-Was the layout of the academic library properly planned?	17	48
4.	-Does the interior design of the academic library help you to encourage you to spend better and more time in it?	22	43
5.	-Is the interior space of the academic library in its current form compatible in design and functionality with the needs of the beneficiaries?	15	50
6.	-Have the internal movement paths been taken into account in the floor plan of the academic library?	22	44
7.	-Does the current internal working environment of the academic library provide for the different needs of cooperative or individual education?	26	39
8.	-Are the appropriate interior furnishing items available in the academic library?	14	52
9.	-Does the current interior design achieve visual communication between the beneficiaries and a sense of familiarity?	15	50
10.	-Are the items of office furniture currently available in the academic library commensurate with its area?	8	57
11.	-Are the office furniture elements characterized by the aesthetic and functional aspects?	8	57
12.	-Is the furniture used flexible and easy to move and rearrange?	15	50
13.	-Were a variety of seating units used to suit the functional needs of the beneficiaries?	10	55
14.	-Did the lighting sources vary between functional and aesthetic lighting?	7	58

Table A1. *Cont.*

No.	Questions	Yes	No
15	-Were the natural light sources in the internal library space used efficiently?	9	56
16	-Are the wooden vertical dividers appropriate for dividing the internal spaces of the library?	12	52
17.	-Is the distribution of book and reference storage units proportional to the library space?	13	52
18	-Are the units for storing and keeping books and references appropriate from the design aspect and dimensions with the rest of the design elements?	13	52
19.	-Is there a reception desk that provides services and inquiries for students and faculty members?	26	41
20.	-Do you prefer developing the current interior design of the academic library?	54	11
21.	-Do the colors used help to feel active and desire to learn?	10	55
22.	-Does the current interior design have electronic research sources?	11	54

Appendix B

Objective: Information gathering about the proposed interior design for the academic library.

Description: The results of the responses of the sample of the faculty members and students in an opinion poll tool consisting of 22 questions about the proposed interior design for the academic library, College of Education, King Faisal University to reveal their opinions and needs.

Table A2. Opinion poll on the proposed interior design for the academic library, College of Education, King Faisal University from the point of view of the beneficiaries.

No.	Questions	Yes	No
1.	-Does the interior design of academic libraries have a major role in providing an attractive and effective learning environment for the beneficiaries?	67	0
2.	-Is the proposed interior design of the academic library commensurate with the requirements of the times?	67	0
3.	-Was the layout of the academic library properly planned?	66	1
4.	-Does the proposed interior design for the academic library help you encourage you to spend better and more time there?	66	1
5.	-Does the interior space of the academic library fit in design and functionality with the needs of the beneficiaries?	66	1
6.	-Have the internal movement paths been taken into account in the floor plan of the academic library?	66	1
7.	-Does the internal working environment of the academic library design proposal provide the different needs of cooperative or individual education?	66	1
8.	-Do the proposed design have the appropriate interior furnishing elements in the academic library?	63	4
9.	-Does the proposed interior design achieve visual communication between the beneficiaries and a sense of familiarity?	67	0
10.	-Are the office furniture elements in the design proposal for the academic library commensurate with its area?	64	3
11.	-Are the office furniture elements characterized by the aesthetic and functional aspects?	67	0
12.	-Is the furniture used flexible and easy to move and rearrange?	64	3
13.	-Were a variety of seating units used to suit the functional needs of the beneficiaries?	61	6
14.	-Did the lighting sources vary between functional and aesthetic lighting?	66	1

Table A2. *Cont.*

No.	Questions	Yes	No
15	-Were the library's internal natural lighting sources used efficiently?	65	2
16	-Are the vertical glass partitions suitable for dividing the internal spaces of the library?	67	0
17.	-Is the distribution of book and reference storage units proportional to the library space?	66	1
18	-Are the units for storing and keeping books and references appropriate from the design aspect and dimensions with the rest of the design elements?	65	2
19.	-Is the reception desk appropriate by design to provide services and inquiries to students and faculty members?	67	0
20.	-Is the proposed interior design for the academic library commensurate with your future aspirations?	65	2
21.	-Do the colors used in the proposed design help to feel active and desire to learn?	61	6
22.	-Does the proposed interior design of the academic library have electronic research sources?	67	0

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How Sustainability-Related Information Affects the Evaluation of Designs: A Case Study of a Locally Manufactured Mobile Tiny House

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Abstract: Sustainability-related information affects people's choices and evaluation. The literature has made significant efforts to understand the best ways of delivering this kind of information to shape consumer behavior. However, while most studies have focused on packaged products and direct information provided through eco-labels, preferences could be formed differently in other design domains. The paper investigates the effect of the perceived amount of indirect information on the evaluation of an architectural artefact. A sample of 172 participants visited a locally produced mobile tiny house, made with a considerable amount of sustainable materials. The same participants answered a questionnaire about their perceived knowledge, quality, appropriateness and sustainability of the tiny house. The general level of knowledge of the tiny house was used as a proxy of the amount of indirect information received. Although the knowledge of the tiny house was generally low, ratings regarding the other dimensions were overall extremely positive. In particular, no evident relation was found between knowledge of the tiny house and sustainability, while the latter is significantly linked to quality aspects. These outcomes deviate from the evidence from other studies; this might be due to indirect vs. direct information and the peculiarity of the study carried out in the field of buildings. The gathered demographic and background data of the participants make it possible to highlight the role played by gender and age in affecting the evaluations, but the absence of a significant impact of experience in the field, education and origin. The results are compared with findings related to the evaluation of sustainable products and green buildings in particular.

Keywords: sustainability; indirect information; awareness; buildings; eco-design; consumer behavior; background

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1. Introduction

The success of sustainable products or solutions in the market is strongly affected by consumers' behavioural attitudes and individual environmental sensitivity [1]. Design for sustainability supports the development of sustainability-related product features, so to favour these pro-environmental preferences and attitudes [2]. Therefore, a strong contribution is expected by designers and product developers, who can follow eco-design directions to guide people towards more sustainable choices. Otherwise said, the design process should be steered to meet the goal of ecologising product ideas without falling into mere greenwashing [3].

As a result, the foci of design for sustainability include the development of sustainable features at the product level that can arouse awareness at an individual or collective level. However, tailored design methods to affect those behaviours are not mature yet, as witnessed by the fact that the systematic integration of people's behaviour into design processes for sustainable products has only recently been outlined [4].

Among the first attempts to affect consumer behaviour, priming [5,6] is an experimental design technique adaptable to a sustainability-related context. The use of visual primers could indeed facilitate positive outcomes from the consumers' decision-making processes regarding the evaluation or choice of sustainable products over standard alternatives. MacDonald and She [7] proposed a model to enhance a proper consumer-driven approach and provide designers with sustainability-oriented recommendations to exploit the full potential of the use of sustainable information. A similar approach was adopted in [8], where Shades of Green were proposed to help designers, researchers and industries in structuring their sustainability communication.

It should also be highlighted that social awareness in terms of sustainability could be enhanced not only by priming and steering people's preferences, but also by spreading knowledge about sustainability. According to [9], a proper diffusion of knowledge about sustainability issues could indeed affect consumers' perception of their individual impact on the environment, possibly raising their willingness to make more informed and ecological choices. As a consequence, considering sustainability information in design processes is critical to the success of sustainable products on the market [10]. The impact of elicited sustainability information on consumers' thoughts and choices has been widely studied by many design scholars. Shared conclusions can be summarised as follows.

First, clear sustainable information can positively affect people's sustainable behaviours, e.g., buying a sustainable product [11,12]. Consumers tend to evaluate sustainable products more favourably if a sustainable solution or advertisement is clearly presented [13]. According to [14], consumers are more prone to contribute actively to sustainable development with such clear and informed sustainability knowledge. These conclusions are consistent with [15], which stated that transparent sustainable product features touch the social and moral responsibility of consumers, hence involving them in the greening of consumption.

Second, making sustainability-related product features apparent results in a more eco-conscious product evaluation [16]. The intentional omission of key sustainability information could result in an inaccurate communication of the environmental benefits of a product, leading to its failure on the market. Declared or implicit omission should only be adopted for customary product choices, which sustainable products do not usually range within, e.g., [17].

Third, the consideration of sustainability-related performance in the early stages of the design process commonly leads to a raised social and moral awareness about sustainability issues [18].

However, it is worth stressing that the provision of sustainability-related information is controlled in most studies, especially in the design field. This situation is not common in real-world scenarios, especially in some domains such as the building industry (see Section 2 for more details). Designers might face situations in which the evaluation of their developed products is affected by uncontrolled circumstances and exchanges of information, e.g., [19], including sustainability-related performance. The paper swivels on this core aspect and originally investigates the impact of the uncontrolled provision of knowledge on people's evaluation, along with a number of factors that are more traditionally considered and manipulated. The experiment in the present study regards a prototype of a green building as a paradigm of a newly developed product benefitting from people's evaluation. In the experiment, information about the prototype's features was provided to participants in an uneven, uncontrolled and indirect way.

The specific objectives and research questions are presented in Section 2, following a literature review. The subsequent sections are as follows. After an overview of the methodology (Section 3), the results are shown in Section 4. While Section 5 includes discussions, the conclusions are drawn in Section 6.

2. Literature Review

2.1. Forms of Sustainable Information and Other Factors Affecting Preference and Choice of Products

As reported in the literature, sustainability information can be presented and communicated mainly in direct and indirect forms.

As regards direct forms, the sustainable features of a product can be made visible through visual cues, the use of which has been deeply investigated in the literature regarding their actual effectiveness and impact on consumers' perception, e.g., [20]. A typical example of direct forms is represented by eco-labels, which represent an intuitive and easy-to-construct way of sharing knowledge visually. They constitute a functioning logic to indicate the enhanced environmental performance of sustainable products over their standardised versions. As a result, their contribution to sustainable development has been extensively addressed by researchers [21]. Studies on the impact of sustainability labelling on purchase intentions and the quality perception of products can be found in [22,23]. D'Souza and colleagues [24] developed a framework of cognitive perspectives of sustainable products to possibly increase the impact and effectiveness of unclear or difficult to understand eco-labels. Indeed, sustainability information should always be coupled with direct and empathic effects on consumers' attitudes and choices. In this regard, an eye-tracking experiment was conducted in [25] to detect the amount of visual attention given by participants to different eco-labels. They showed that labels generated a perception of compliance with sustainable aspects in most participants. Therefore, it is imperative for eco-labels to connect with consumers' individual environmental perception. An effective improvement of their use could focus on enhancing their visibility and their diffusion in consumers' habitual purchasing habits [20].

Indirect or diffused forms of sharing knowledge could be adopted too—placing eco-labels on packaging cannot apply to all forms and categories of designs. In-depth studies about this typology of sustainability-related information sharing are fewer. An example is presented in [3], where participants were provided with a set of information about different typologies of the same product, which did not directly refer to their environmental impact. Therefore, the sustainability-related characteristics should have been inferred here. Another example is [26], which deals with the communication of sustainable information related to a university campus by managing sustainability communication based on a combination of marketing strategies and surveys' submissions. Similarly, Saber and Weber [27] investigated the sustainability communication in supermarkets and retailers.

Beyond the presentation of information through design, it has already been highlighted in Section 1 that collective and individual factors play a role too.

As for collective and social factors, research has paid great attention to cultural aspects; cases in point are [28,29]. A more complex network of contextual and social factors affecting design evaluation is illustrated in [30].

In relation to individual aspects, a large amount of literature has focused on the background and demographic data of the evaluators, e.g., [31–33]. Liu and colleagues [34] show the psychological factors affecting the choice of green buildings. Great emphasis is given here to environmental attitude and general knowledge. In relation to personal knowledge and understanding, the effects on product evaluation are also studied in terms of familiarity [35], expectations [36,37], and, more broadly, values [38]. Here, it is to be highlighted that the concept of knowledge differs from mere information acquisition, e.g., [39]. In most of the studies illustrated above with regard to forms of sustainability-related communication, it is hard to infer if the provided information has been properly processed by individuals.

2.2. Perception and Evaluation in the Field of Constructions and the Built Environment

The previous subsection has shown that forms of information delivery might differ and that the effect of its elaboration is hard to study. Most research is conducted in simulated laboratory settings and the validity of results might be challenged in real-world scenarios. It can be also hypothesised that different design domains have typical ways

of exposing potential consumers to products and offering information. In the present paper, particular attention is paid to the building industry. This domain lends itself to the development of designs where direct (sustainability-related) information is hardly included in the representation of the products, which is seldom considered according to the previous subsection.

Table 1 summarises how previous literature has dealt with the evaluation of buildings and the built environment (markedly urban spaces) where sustainable aspects were involved. The columns of Table 1 report the following aspects, respectively.

- The considered source.
- How participants have interacted with the designs so as to compare the case studies with real-world situations and to infer how they could shape their evaluation.
- The methods used to extract perception and evaluation data.
- The size of the sample and characteristics of participants.
- Additional critical information about the way the studies have been conducted and other relevant data, markedly about knowledge, collective and individual aspects.

Table 1. Summary of extant literature contributions dealing with the evaluation of sustainable designs within buildings and the built environment.

Source	Representation and Interaction Mode	Investigation Method	Participants' Sample	Research Protocol and Relevant Data
[40]	Real user experience collected in traditional and modern buildings in Cameroon	Questionnaire	1750 questionnaires were answered depending on the residents' geographical area	- the participants were aware of the characteristics of the residential area - data about socio-demographic questions and residential experience was collected
[41]	Rendering and 3D models of a future neighborhood redevelopment project	Questionnaire	269 respondents selected in a specific neighborhood	- the participants were not aware of the characteristics of the future buildings - data about socio-demographic questions and residential experience was collected - preferences evaluation was based on an 11-point rating scale
[42]	Rendering and picture of a post-industrial landscape renovation	Questionnaire	450 residents randomly selected	- the participants were aware of the characteristics of the residential area - data about socio-demographic questions and residential experience was collected
[34]	Experiences with green buildings	Online survey	342 residents (valid answers)	- the participants reported an experience a posteriori; no evaluation of a new design - data about background and some demographic factors were collected
[43]	Real-world experiments at the Department of Civil Engineering of the University of Aveiro, Portugal.	Questionnaire	150 random users among students, researchers, professors, and administrative staff	- direct questionnaires were administered with enquiries about water consumption behaviour and preferences - the participants were not aware of the characteristics of sustainable water consumption behaviours - no socio-demographic or background questions were asked

Table 1. *Cont.*

Source	Representation and Interaction Mode	Investigation Method	Participants' Sample	Research Protocol and Relevant Data
[44]	User experience of life in a temporary house	Questionnaire and interviews	32 families interviewed and 181 questionnaires collected	- the participants were aware of the characteristics of the buildings; - no socio-demographic or background analysis was performed - interview and questionnaire made to understand the importance of the space and the sustainability of the used material
[45]	Rendering and pictures of 32 scenario of built environment design	Questionnaire	752 respondents divided into three different groups of target population that included building users/building owners, road users	- the participants were not aware of the characteristics of the buildings - socio-demographic and background information was collected
[46]	Two real buildings for demonstration scopes	Interviews	61 participants with different degrees of experience	- the participants were aware of the characteristics of the buildings - 32 in-depth, semi-structured interviews with building professionals were conducted - 29 shorter interviews with building users were conducted
[47]	Pictures of six selected urban streets in the city of Seoul	Interviews	Six experts in public space, transportation, and behaviour	- the participants were not aware of the characteristics of the urban streets - no socio-demographic or background analysis was performed - sustainability, amenity, placeness and accessibility of the urban streets based on open questions were evaluated
[48]	Five scenarios (electricity production; vegetable; green roof implementation and rainwater harvesting) of future development of a residential area in Barcelona	Questionnaire	60 respondents selected among residents, experts and public institutions	- the participants were not aware of the characteristics of the residential area - no socio-demographic or background questions were asked - respondents used a 5-point ranking of the scenario considering sustainability, environmental, economic and social indicators
[49]	Rendering and pictures of 160 wood constructions	Questionnaire	159 respondents selected among wood construction users	- the participants were aware of the characteristics of the building - background and demographic questions were asked - open questions were added - sustainability and economic criteria were evaluated

2.3. Literature Gap and Objectives

The collected literature shows that:

- Most of the designs were evaluated by experts or people with a significant awareness of the contextual factors related to buildings and urban spaces. The evaluation of ordinary people is rarely dealt with, while their views are critical when it comes to preferences, choices and purchases.
- In a few cases, real-world situations were studied; among them, very peculiar aspects were focused upon, see [43]. Conversely, the experience found with designs, especially if they present innovative features, is much more reliable if actual artefacts are involved [50]. In the case of green buildings or sustainable-oriented architectural interventions, it is assumed that new characteristics are included to fulfil the requirements of increased sustainability.
- The knowledge of the presented designs is dissimilar across participants of different studies but poorly considered as a factor affecting evaluation and acceptance in those contributions with participants having different degrees of awareness.
- A large number of studies consider demographic and background data, which have proven critical to evaluations.

In this context, an appropriate study for the evaluation of a green building should include:

- The use of a real building or realistic prototype even though this may be inconvenient because of the size of artefacts in the construction industry.
- The involvement of ordinary people.
- The consideration of people's knowledge and its effect on evaluations and perception, where information is provided in an indirect way, which is more realistic in a real-case scenario.
- The consideration of people's background and demographic data, along with their effect on evaluations and perception.

The present study is organised consistently with the above requirements, where the consideration of bullets 1 to 3 represents an original aspect, since they are not found contextually in the extant literature.

The objectives of the paper are to study the following:

1. Ordinary people's overall perception and evaluation of a real green building;
2. To what extent the (perceived) knowledge of the properties of a sustainable building affects evaluation and perceived sustainability, which contribute to product desirability and choice as shown above;
3. The effect of background and demographic data on perception and evaluation;
4. The interplay between multiple evaluation criteria to get more insight into the evaluation phenomenon.

3. Methodology and Context of the Study

3.1. Research Design

The study was conducted within the project "Tiny FOP MOB—A Real World Laboratory made of wood and hemp travelling through the Vinschgau Valley". The acronym FOP MOB (in German, FOrschungs- und Praxis-MOBil) recalls the main objective of this research project, namely, to design and develop a mobile Real-world Laboratory (RwL). The concept of the RwL has gained traction in the last decade and is breaking into the design domain too [51]. The building prototype (hereinafter Tiny FOP MOB) is therefore a mobile tiny house that was designed and constructed to represent a sustainable example in the building sector because of the materials used and their local origin (see below).

The project scopes align with the pursuance of the research objectives and the prototype has been used as a case study to address the objectives. The research procedure is shown in Figure 1, where the major steps are indicated along with the paper's sections where these steps are described. In particular, an experiment involving volunteer participants was designed and conducted, made more apparent in the following subsections.

Participants were asked to visit the prototype and provide feedback by means of a questionnaire. Experiments were initially approved by the statistical office of the project leader (EURAC Research) and the ethical commission of the Free University of Bozen-Bolzano, Bolzano, Italy. Both these institutions are located in South Tyrol, a bilingual (German and Italian) region in Italy. Questionnaires' outcomes were subsequently collected to conduct a statistical analysis, intended to correlate variables of interest related to the evaluation of perception of the Tiny FOP MOB and relevant according to research objectives. A correlation analysis was carried out to capture the links across a large number of variables; regressions were not used, as the goal was not to predict evaluations based on potential causal factors. Correlation functions (Spearman, Somer's D) were chosen based on the involved variables—details are to be found in Section 4. As aforementioned, results were critically discussed (Section 5) with a focus on the effects of perceived knowledge, background and demographical data on the evaluation of the prototype, consistent with the research objectives.

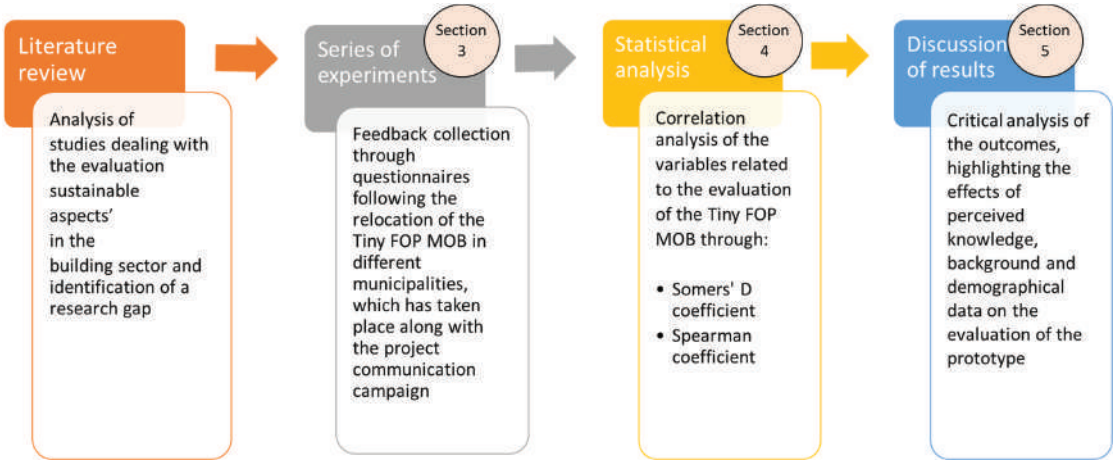

Figure 1. Research procedure schematised into steps and the following sections mostly devoted to illustrating such steps.

3.2. Product and Characteristics Thereof

The Tiny FOP MOB was designed and manufactured by two local companies of South Tyrol, Italy, more specifically of the Vinschgau Valley. The prototype was produced with natural materials, e.g., a mixture of hemp, lime and water for the building blocks, wood for external coatings and furniture elements. Sustainable peculiarities of the Tiny FOP MOB include the materials utilised, which are almost zero-kilometre, but also the entire process of development and construction. The environmental impact of the building blocks is CO_2 negative based on preliminary estimates. As a result, the Tiny FOP MOB was supposed to stimulate people to think about sustainability in the building sector and provided a concrete example thereby. Its use as a RwL further stressed its sustainable orientation from a social viewpoint.

The Tiny FOP MOB is mounted on a trailer, and, thanks to this feature, it could be transported in different towns of the Vinschgau Valley (see the next subsection). The prototype is illustrated in Figure 2 (outside) and Figure 3 (inside).

Figure 2. The Tiny FOP MOB prototype (exterior view).

Figure 3. The Tiny FOP MOB prototype (interior view).

3.3. Relevant Information about the Project

The mobility of the Tiny FOP MOB mirrors its scope to work as an RwL and matches its ability to spread knowledge about sustainability and related research outside major towns in South Tyrol, where research facilities are located. Consequently, a shared travel calendar was established in order to stop the Tiny FOP MOB in five pilot locations in the Vinschgau Valley, following consultations with local authorities. The prototype was moved to the localities of Schlanders, Mals, Latsch, Prad am Stilfserjoch and Graun im Vinschgau in the period of July–November, 2021. Additional tests were performed in spring 2022 in Schlanders where the Tiny FOP MOB is currently parked at the time of writing (June 2022). The prototype route throughout the Vinschgau Valley, as well as key information about the project's objectives, were described in newspaper articles by the local press, on the project website and in informative materials distributed in the above towns. Materials were made available in the surroundings of the prototype (in the form of informative posters) in line with the instructions reported in the next subsection. A number of initiatives about sustainability with specific reference to the building sector were organised too. It follows that participants' awareness of the project, the design requirements of the Tiny FOP MOB and, mainly, the delivery of information about sustainability-related aspects, could not be controlled and was uneven across participants. These circumstances justify the research objective (see Section 2) of understanding the impact of sustainability information shared

at a social level, in indirect forms, and to different extents, across participants. In other words, the sustainability information addressed in this work can be indicated as diffuse and indirect, in contrast with the direct form provided, for instance, by eco-labels.

3.4. Participants and Relevant Aspects of the Experimental Procedure

The sample of convenience for this study was formed by 172 participants who took part in the experiment. Participants were directly recruited on the location sites of the prototype. All adults represented potential participants irrespective of their background, education, gender, reason for being in the Vinschgau Valley, e.g., residence, tourism, work. Participation was voluntary; all passers-by in the five localities in Vinschgau Valley were invited to visit the Tiny FOP MOB and answer the questionnaire (see below). Participants just had to confirm being at least 18 years old due to ethical and legal issues. After recruitment, participants were informed of the following guidelines and rules of conduct.

- Specific information about product peculiarities would have been given only after the visit unless this was explicitly requested to the experimenters before or during the visit; as well, paper-based or online informative material about the project and the Tiny FOP MOB was given to participants based on their requests.
- A scheduled timetable was not planned by providing participants with the chance to observe the prototype as long as they wanted and needed. If the Tiny FOP MOB was free at the time of recruitment, the visit could take place immediately.
- A limitation on the number of simultaneous visitors was imposed, together with the rule of wearing a mask inside the Tiny FOP MOB, due to the COVID-19 pandemic situation at the time of the experiments.

Background, personal and demographic data was also requested, which included:

- Gender;
- Age range (options: 18–30, 31–40, 41–50, 51–60, 61–70, 71+);
- Origin, markedly if the participant lived in a South Tyrolean municipality;
- Education (options: primary school, secondary school, high school, second-level vocational school, University degree, Ph.D.);
- Job.

Participants were left free to skip some answers if they believed the provided data could violate their privacy. Apart from missing information, the final sample was constituted by:

- 63 men and 79 women;
- 39 people aged 18–30; 24 people aged 31–40; 22 people aged 41–50; 38 people aged 51–60; 9 people aged 61–70; 8 people aged 71 or older;
- 84 South Tyroleans and 59 people whose residency was outside South Tyrol;
- 2 people with primary school; 10 people with secondary school; 44 people with high school; 17 people with vocational school; 54 people with an University degree; 15 people with a Ph.D. degree;
- 14 people working as architects, engineers, urban planners, entrepreneurs or managers in the building or wood industry, who could be considered experts in the field; 129 non-experts.

3.5. Questionnaires and Extracted Variables

As evident from Table 1, questionnaires have turned out to be the most used method to acquire information about people's evaluations, especially in the building industry. As aforementioned, questionnaires were also used in the present research.

The questionnaires were developed and used during the whole duration of the experiments in German and in Italian. Participants could choose to fill in questionnaires either paper-based or online. The main purpose of the questionnaire was to investigate comfort, perception of the Tiny FOP MOB and participants' opinions concerning global challenges beyond personal and background data. The total time needed to complete the

questionnaire was approximately 15 min; no data potentially leading to the identification of respondents was collected.

With regard to the addressed objective of the paper, this subsection, along with the paper as a whole, presents the questionnaire's part (translated in English) concerning the perception of the quality and sustainability of the Tiny FOP MOB. The Institution the authors belong to was in charge of the design of this part of the questionnaire and analysed the corresponding results. This part of the questionnaire included 13 different statements (see Table 1) to be evaluated by means of a Likert scale ranging from 1 ("Totally disagree") to 5 ("Totally agree"). The statements in Table 2 are reported alongside the name of the corresponding variables that are manipulated in the next sections.

Table 2. Questionnaire's list of statements and variable names related to knowledge, perception, quality and sustainability.

Statement	Variable	Source or Precedent for Using the Variable
1. I knew the Tiny FOP MOB and the associated project before the visit.	Knowledge	[10]
2. The Tiny FOP MOB is a good quality product.	Quality	[10]
3. The Tiny FOP MOB represents a product to be preferred over other types and competing products.	Preference	[10]
4. The Tiny FOP MOB has many advantages over other types and competing products.	Advantages	[10]
5. The Tiny FOP MOB has no disadvantages compared to other types or competing products.	Lack of disadvantages	[10]
6. The Tiny FOP MOB is a creative and original product.	Creativity	[10]
7. The Tiny FOP MOB could be a branded product of South Tyrol.	Brand	[52]
8. I would willingly stay in the Tiny FOP MOB for a shorter or longer period of time.	Staying	[53]
9. The Tiny FOP MOB is a suitable building module to live in permanently.	Living	[53]
10. The Tiny FOP MOB is a suitable building module for organising small conferences/seminars.	Seminars	[53]
11. The Tiny FOP MOB is a building module that is suitable as a workplace.	Workplace	[53]
12. The Tiny FOP MOB is a suitable building module to spend the holidays in.	Holidays	[53]
13. The Tiny FOP MOB is a sustainable product.	Sustainability	[54,55]

The first statement directly enquires about the different levels of knowledge about the product and the project itself. The variable "Knowledge" has provided the authors with an indication of whether participants were aware of the project's characteristics and scopes, but without specific details about how they acquired this knowledge due to the project's limitations. This kind of information is strictly related to the need to pursue the second objective mentioned in Section 2.3.

The questions concerning quality (2 to 6) were taken from an already available list of statements [10], which survey the quality perception in the domain of sustainable products. These questions address a number of aspects aimed at forming choice and preference of sustainable products over alternatives. These questions target primarily the first objective mentioned in Section 2.3.

The questionnaire is integrated with bespoke statements related to the project and the investigated product, i.e.,

- Brand identity (7), as a measure of the product's capability to fit and represent the South Tyrolean territory, similar to [52];

- Suitability for different purposes (8 to 12) in order to assess the perceived capability of prototype to serve some of the scopes it could potentially fulfil, as in [53];
- Perception of sustainability (question 13), which is closely targeted in the present work because of its dealing with sustainable design. Precedents of investigating the perception of designs' sustainability can be found in [54,55].

The variables 7 to 13 can complement the quality perception in the pursuance of the paper's objectives, markedly the fourth one, reported in Section 2.3.

4. Results

4.1. Objective 1: Overall Perception and Evaluation of a Green Building

Beyond the participants' perception of knowledge, the questionnaire was intended to reveal a number of aspects related to the evaluation of the Tiny FOP MOB. Consistently with the objectives, ordinary people were involved in the evaluation, as the general description of the sample and the fact they were passers-by should suggest.

Table 3 includes the number and the frequency (in percentage terms) of answers for each variable. The median is also reported. Some participants skipped some questions; therefore, the totals of the rows slightly differ. A statistical analysis was performed with the software SPSS, PASW Statistics version 26 (IBM Corporation) by using data of each participant—the same software application was used for all the statistical analyses. Regarding the distribution of the results, the median and mode of the variable [Knowledge] is 1, which means that most of the participants seemingly had little to no information about the project before and during their participation in the experiment. As for the rest of the variables, the values are predominantly mainly between 3 and 5. While all these variables denote an overall positive perception of the Tiny FOP MOB, the high values attributed to [Sustainability] and [Creativity] are particularly noteworthy.

Table 3. Number of answers for each variable of the perception questionnaire reported along with percentages and medians.

Variable	Totally Disagree (1)	%	Somehow Disagree (2)	%	Indifferent (3)	%	Fairly Agree (4)	%	Totally Agree (5)	%	Median
1. Knowledge	91	55.5	12	7.3	30	18.3	13	7.9	18	11	1
2. Quality	1	0.6	2	1.9	6	3.7	76	46.9	77	46.1	4
3. Preference	2	1.2	5	4.3	45	28	68	42.2	41	24.6	4
4. Advantages	1	0.6	1	0.6	50	31.3	64	40	44	27.5	4
5. Lack of disadvantages	5	3.2	11	7.1	63	40.4	60	38.5	17	10.9	3
6. Creativity	2	1.2	5	3	8	4.8	55	33.1	96	57.8	5
7. Brand	3	1.8	9	5.5	27	16.6	61	37.4	63	38.7	4
8. Staying	3	1.9	10	6.3	31	19.4	64	40	52	32.5	4
9. Living	5	3	14	8.4	38	22.9	53	31.9	56	33.7	4
10. Seminars	4	2.4	9	5.5	17	10.4	70	42.7	64	39	4
11. Workplace	2	1.2	5	3	15	9	66	39.8	78	47	4
12. Holidays	1	0.6	5	3.1	19	11.7	49	30.1	89	54.6	5
13. Sustainability	2	1.2	0	0	3	1.9	36	22.2	121	74.7	5

4.2. Objective 2: Effect of the Perceived Knowledge on the Evaluation of the Prototype

Based on the paper's objectives, particular focus has been given to the relationship between the previous knowledge about the Tiny FOP MOB project [Knowledge] and the perception of the tiny house after the visit. This objective has been addressed by calculating the Spearman's correlation between [Knowledge] and the other variables. Here, this association function has been chosen because of its suitability for ordered variables.

Given the focus of the research, specific attention was paid to the effect of [Knowledge] on [Sustainability]. However, it emerged that the correlation between the variables [Knowledge] and [Sustainability] was 0.068. Hence, this correlation was almost absent according to Landis and Koch's [56] interpretation and non-significant ($p = 0.391$).

The correlations between [Knowledge] and the other variables were also weak and non-significant, as for example [Knowledge] and [Preference] (0.129).

4.3. Objective 3: Effect of Background and Demographic Data on the Evaluation of the Prototype

The individual and demographic data described in Section 3.4 were used as background variables. They were correlated with the perception variables described in Section 3.5 in order to study how the background of the participants affected the results.

The statistical functions used to analyze the correlations between these groups of variables were Somers' D coefficient and Spearman correlation, due to the nature of the variables. Somers' D was used to compare ordinal and nominal variables (gender, origin and job), while Spearman correlation has been used for pairs of ordered variables in compliance with [57]. The significant correlations found between the background and the evaluation variables can be seen in Table 4. The third column indicates the category or the property associated to the background variable for which larger values of the corresponding evaluation variables were obtained.

Table 4. Number of answers for each variable of the perception questionnaire reported along with percentages and medians.

Background Variable	Evaluation Variable	Direction (Increasing)	Strength of Correlation	*p*-Value
Gender	3 Preference	Woman	0.228	0.011
	6 Creativity		0.175	0.035
	7 Brand		0.237	0.008
	8 Staying		0.239	0.009
	9 Living		0.244	0.007
	10 Seminars		0.280	0.001
	11 Workplace		0.221	0.011
	12 Holidays		0.263	0.002
	13 Sustainability		0.147	0.045
Age	5 Lack of disadvantages	Younger	0.308	0.0003
	7 Brand		0.248	0.003
	12 Holidays		0.269	0.001
	13 Sustainability		0.237	0.005

The gender of participants displayed the largest number of significant relationships with the variables. In all the nine cases for which significant correlations were found, women tended to assign higher values to evaluation variables. On the other hand, origin, job and education were not significantly associated with any of the evaluation variables, and, as such, are not present in Table 4. The age of the participants was significant for four of the variables studied: lack of disadvantages, brand, holidays and sustainability. In all these cases, younger people tended to provide higher evaluations to the Tiny FOP MOB.

4.4. Objective 4: Interplay among Evaluation Criteria

In order to compare the evaluation variables, a Spearman's Correlation analysis was performed, as they were all order variables. The results of the analysis are presented in Table 5, which includes the magnitude and the significance of the correlation. In this respect, the option was adopted of the SPSS software to flag the correlations at the *p*-value thresholds 0.01 (**) or 0.05 (*), as a common rule of thumb.

Table 5. Correlations among evaluation variables.

	2 Quality	3 Preference	4 Advantages	5 Lack of Disadvantages	6 Creativity	7 Brand	8 Staying	9 Living	10 Seminars	11 Workplace	12 Holidays	13 Sustainability
2 Quality	-											
3 Preference	0.516 **	-										
4 Advantages	0.422 **	0.717 **	-									
5 Lack of disadvantages	0.282 **	0.478 **	0.418 **	-								
6 Creativity	0.310 **	0.355 **	0.351 **	0.357 **	-							
7 Brand	0.175 *	0.383 **	0.341 **	0.242 **	0.406 **	-						
8 Staying	0.343	0.287	0.227	0.290	0.344	0.136	-					
9 Living	0.233 **	0.367 **	0.221 **	0.319 **	0.295 **	0.381 **	0.497 **	-				
10 Seminars	0.229 **	0.254 **	0.152	0.154	0.351 **	0.240 **	0.370 **	0.444 **	-			
11 Workplace	0.183 *	0.252 **	0.110	0.187 *	0.217 **	0.265 **	0.366 **	0.504 **	0.493 **	-		
12 Holidays	0.129	0.240 **	0.149	0.178 *	0.209 **	0.394 **	0.416 **	0.613 **	0.334 **	0.350 **	-	
13 Sustainability	0.340 **	0.414 **	0.316 **	0.236 **	0.475 **	0.267 **	0.297 **	0.305 **	0.194 *	0.304 **	0.243 **	-

No correlations across all the variables presented negative values showing the absence of inverse relations.

Through Figures 4–6, it was possible to gain insight into some of the strong correlations emerging in the analysis. These figures show, by means of the size of bubbles, the number of co-occurrences of values attributed to the considered pairs of variables. In particular, the highest correlation could be found between [Advantages] and [Preference] (0.717) (Figure 4), which led us to consider these quality dimensions possibly redundant, although they are, in principle, distinct.

The correlations of [Sustainability] with other variables were significant in many cases. The measures of association between [Sustainability] and the other evaluation variables varied between 0.194 ([Seminars]) and 0.475 ([Creativity]). The perception of sustainability was significantly correlated with all the other variables, especially with [Preference] (Spearman correlation 0.414) and [Creativity] (Spearman correlation 0.475) (Figures 5 and 6). Regarding the association between the variables concerning quality and appropriateness, they mainly exhibited slight to moderate correlation.

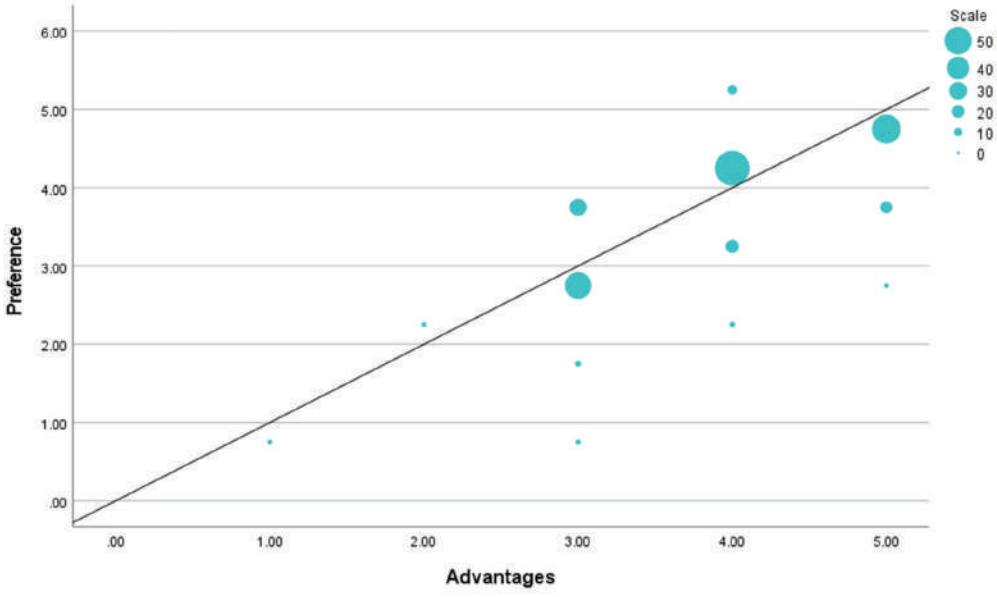

Figure 4. Relationship between Preference and Advantages.

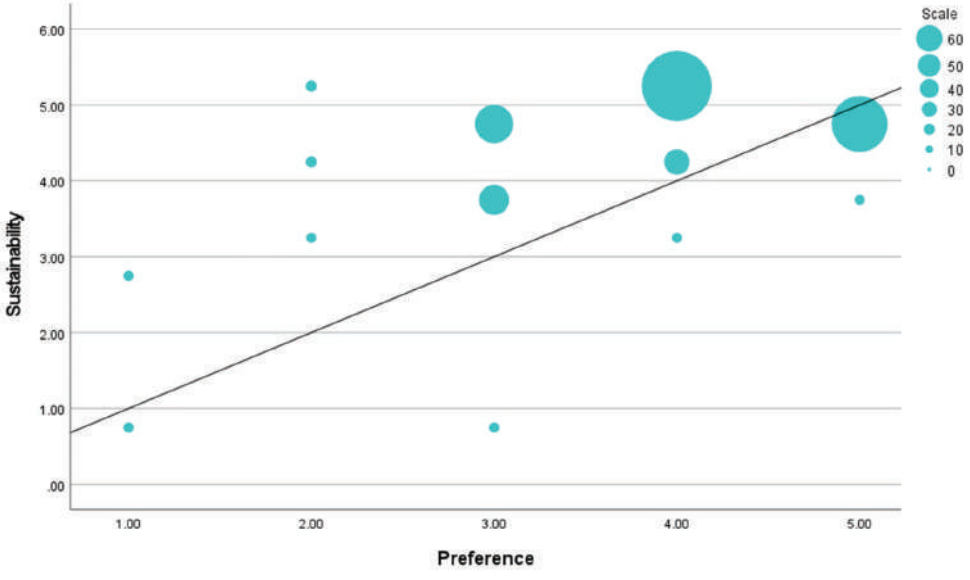

Figure 5. Relationship between Sustainability and Preference.

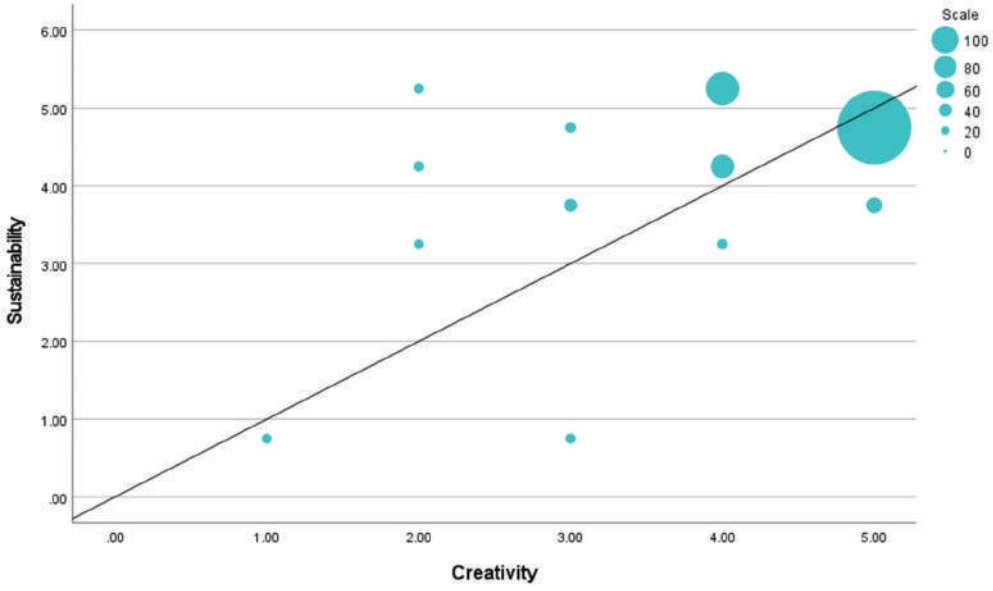

Figure 6. Relationship between Sustainability and Creativity.

5. Discussions

The present section is devoted to critically discussing the outcomes of the study and suggesting their interpretation and implications. The original aspects of the study and the requirements for a thorough investigation of a green building, recalled in Section 2.3, prevent the comparison with very similar studies. Therefore, comparisons of the findings are largely affected by a large number of contextual factors and differences in the settings of the studies.

5.1. Objective 1: Overall Perception and Evaluation of a Green Building

As regards the first stated objective, the aim was to study ordinary people's overall perception of a physical building implementing sustainable characteristics. The results showed that the evaluation of the Tiny FOP MOB prototype was very positive across a considerable number of evaluation criteria ranging from identification of advantages to appropriateness, creativity and sustainability.

These results support the positive attitude towards green buildings across several factors that were found in [34], where participants were surveyed after living and having experienced green buildings. However, post-occupancy evaluations of green buildings do not always show high satisfaction levels, e.g., in [58]. Likely, the characteristics of what makes a building greener or more sustainable might play a role in this respect and more research is therefore needed. When switching the attention to sustainable products and other forms of designs, evaluations differ substantially as well, e.g., in [10].

With reference to the attainment of this objective, it must be nevertheless noted that the sample of participants was random, but the volunteer participation could make it poorly representative of "ordinary people". It could be hypothesised here that those willing to participate had an aprioristic positive view of the presented design, which justifies the high evaluations shown in Table 3. This might explain why the knowledge of the product acquired by participants did not affect their perception of sustainability and quality (see Section 5.3).

5.2. Objective 2: Effect of the Perceived Knowledge on the Evaluation of the Prototype

In relation to this focal research objective, the results conflict with past research findings (see the abundant literature presented in Sections 1 and 2.1) where the role of knowledge and awareness of the sustainable properties of products has largely affected the perception of sustainability and preferences. The possible causes of misalignment with previous studies are discussed below along with pointing out some peculiarities and limitations of the study.

- The aforementioned peculiar contextual factors, such as unevenness of information given to participants, knowledge possibly coming from different sources and in different modalities, etc., are candidates to explain the divergence of the presented results from previous work.
- While all the analysed answers are inherently subjective, this might particularly apply to knowledge, as each participant could have evaluated differently the amount of information processed and the lack of necessary knowledge to assess the prototype in a fully aware manner. In other words, the impossibility of verifying the metrics used by participants to provide [Knowledge] values represents an important limitation of the paper, besides being a difference with respect to most previous literature.
- An additional hypothesis is that a tiny house, clearly built with natural materials, might be considered per se a sustainable product; hence, details about the project, such as the planned use of the Tiny FOP MOB for an RwL or the origin of materials, could have poorly oriented evaluations. In other terms and with a closer look at the design research, the product considered could lend itself to effective indirect communication of sustainable aspects.

5.3. Objective 3: Effect of Background and Demographic Data on the Evaluation of the Prototype

With regard to the role played by factors concerning the participants in the experiment, few significant correlations were found. The effect of demographic factors emerged overall as greater than the impact of background factors, such as experience in the field and education.

On the one hand, the fact that gender and age affected the evaluation of a green building is in line with [59], where experience was targeted. Additional similarities with [59] include the fact that correlations with occupation were not found and that more positive evaluations were typically given by women and younger people. Nevertheless, while the factors significantly affected by age and gender differed, the results of the present study showed that some impacted factors were shared here, notably including the perception of sustainability.

On the other hand, a major dissimilarity of the present study with respect to past literature and a counterintuitive aspect concerns the undetected effect of background variables. Different results can be found markedly in [34,58].

As an additional factor considered despite the absence of significant correlations, people's origin cannot be considered as a factor underlying strong cultural differences (all the participants were European with Italians, Germans and Austrians constituting nearly the whole sample). Therefore, it would be inappropriate to compare the achieved results with studies treating the effects of cultural aspects.

5.4. Objective 4: Interplay among Evaluation Criteria

The variety of questions and the considerable number of participants allow further reflections beyond the relation between knowledge and perceived sustainability. As [Sustainability] has proved to be largely correlated with quality and appropriateness variables, one might conclude that sustainability is increasingly considered as a necessary design requirement, at least for a subset of people. A consequence might be that the frequent design need to find a trade-off between quality and sustainability is nowadays alleviated. The data gathered in this work conversely suggest that sustainability is a prerequisite for quality and positive experiences. The strong relation between [Creativity], a plainly

important dimension in the design field, and [Sustainability] has already been underlined. This link is confirmed by abundant literature stating that people more prone to novelty are also expected to welcome changes driven by sustainability requirements [60].

As far as quality variables are concerned, the degrees of correlation have resulted much larger than in other studies where different evaluation criteria were compared against each other, for instance, in [10]. More research is needed in this area in order to standardize evaluation procedures for sustainable products and use a comprehensive and non-redundant number of questions for characterizing the participants' experience.

6. Conclusions

The paper has investigated the relationship between the perceived knowledge and sustainability of a sustainable product along with other evaluation criteria. From a methodological point of view, the objective was pursued through a questionnaire, which included the quality evaluation of a tiny house prototype, followed by correlation analysis. As aforementioned, sustainable information was provided in an indirect and diffuse form, differently from most cases presented in the literature, which deal with a direct form of sustainability-related information, e.g., eco-labels (see Section 2).

In relation to the four objectives declared in the present study, the most significant findings are listed below:

1. The tiny house received consistently positive evaluations concerning its perceived quality, creativity, appropriateness and sustainability. The majority of evaluators were randomly selected volunteers with a limited number of experts in the field. As such, the involved sample could be considered as well representative of a group of ordinary people despite the participants' likely intrinsic interest towards the product and their probable sustainable attitude.
2. Prior knowledge about the tiny house and the project within which it was designed, developed and built played no evident role in the evaluations.
3. People's background did not affect evaluations significantly either. In contrast, some evaluation variables were affected by gender and age, where women and younger people overall rated the tiny house better in terms of sustainability and other factors.
4. The chosen evaluation criteria were shown to be significantly correlated with a remarkable association between perceived sustainability vs. preference and creativity.

Future work includes the attempt to overcome the limitations mentioned in Section 5, as well as to launch new experiments to understand the role of contextual factors and methodological choices. In particular, an experiment in a laboratory environment is ongoing where the visit of the physical prototype is substituted by a virtual tour and the provision of information is controlled. Possible differences in the results will be used to assess the extent to which user experience changes in a virtual environment (which was assumed in the present paper) and the effect of changing the way information is supplied to participants.

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