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Original Research Article

Explaining the Quality of the Architectural Space in Academic Libraries Based on User Preferences

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Abstract

Problem statement: Although the unwillingness of students to use academic libraries may have such reasons as the interference of class times with the working hours of libraries, the spread of electronic resources, and easy access to them through applications that can be installed on cell phones and computers, the architectural design criteria in academic library spaces can also affect in the lack of presence of users.

Research objective: The present research aimed to identify criteria that lead to the maximum attraction of users and increase their presence in academic libraries while improving the quality of the architectural space of academic libraries.

Research method: Using a qualitative approach, this research was done by the grounded theory method. The data obtained from semi-structured interviews with 14 users of 5 academic libraries in Tehran were coded in the three phases of open, axial, and selective coding. 33 propositions were obtained as open codes. Axial codes were extracted from 20 main categories and finally, 5 cores were recognized as the selective codes.

Conclusion: Providing spaces for leisure time and relaxation, views of vegetation, diverse visual views, the possibility of group discussion, the environmental comfort in the study halls, considerations related to the privacy of visual connection between the women's spaces and other library spaces, spatial organization, functional quality of furniture and shelves (suitable furniture for long-term sitting and observation of ergonomics), and management and planning for human resources were determined as factors affecting the desirability of academic libraries.

Keywords: *Academic libraries, Architecture, Quality of space, User preferences, Grounded theory.*

Introduction

Academic libraries are an integral part of a parent institution that is responsible for supporting the main mission of the university's teaching, learning and research activities (Adam, 2017). Libraries are needed to provide spaces where users can study alone or with others, cooperate in research, and even socialize with each other (Andrews, Wright & Raskin, 2016; DeClercq & Cranz, 2014; Montgomery, 2014; Montgomery & Miller, 2011; Ojennus & Watts, 2017). Therefore,

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the role of academic libraries as social entities in the development of human relationships among students is important because they lead to the institutionalization of a certain type of culture among users (Ojennus & Watts, 2017). Chan and Spodick (2014) argue that space is one of the most valuable assets an academic library possesses so the architectural space of academic libraries should have physical and management characteristics that are appropriate to the needs and wants of diverse groups of users. Academic libraries can be considered hubs of academic life that enhance the educational experiences of students (İmamoğlu & Gürel, 2016). Therefore, it is important to use the physical space of academic libraries for learning (Ching, 2018; Sinclair, 2017; Oakleaf, Whyte, Lynema, & Brown, 2017; Mahoney, 2017; Fallin, 2016; Bennett, 2015; Booth, Schofield, & Tiffen, 2012; Beard & Dale, 2010). As many students spend a long time in libraries to study and conduct research (Applegate, 2009; Suarez, 2007), library space should be comfortable and inviting for users (Ojennus & Watts, 2017). Additionally, the placement of academic libraries on the university campus in a way that provides access and linkage between other spaces of the university (Cunningham & Tabur, 2012) can be an effective factor in increasing students' presence in the library space (Cha & Kim, 2015). During the past decades, many studies have examined the importance of the physical space of libraries by addressing the concept of "library as place" (Applegate, 2009; Holder & Lange, 2014). Libraries are considered a place for informal learning, where students can achieve their research objectives (Montgomery, 2014). Spencer and Watstein (2017) also argue that the spaces of academic libraries today are designed not only to stimulate and support creativity, reflection, exploration, and innovation but also to affect the learning process. Several studies indicated the unwillingness of students to attend and use the space of academic libraries (Cox, 2018), the reasons for which can be the need for regular attendance of students in classes, the spread of electronic books and publications, the possibility of access to digital resources through applications that can be installed on cell phones, computers, tablets (Choy & Goh, 2016). In addition, some management measures such as limited working hours of academic libraries affect the reduced attendance of students and users. Ugwuanyi, Okwor, and Ezeji (2011) argued that the library space can maximally attract users if it includes visual aesthetic features while being inviting. The study by Feizi, Hosseini, Majidi, and Ahmadi (2016) indicated that a set of 10 architectural factors such as lighting, view of the natural landscape, geometric proportions, the flexibility of space due to various types of furniture, flexibility due to interior design strategies, decorations, colour quality, geometric design, non-geometric design in interior space and silence and quietness can improve the architectural space of public libraries so that ensure the users' satisfaction with the presence in the library space. Choy and Goh (2016) also emphasized the important role of physical library space in achieving user-centric missions. The findings of the study by Nazarpour, Norouzian Maleki, and Ahmadi (2019) also pointed to the user-centred approach as one of the effective strategies of the architectural design of academic libraries to improve the students' learning environment. Shill and Tonner (2004) investigated 182 libraries in the United States and Canada and found that improving the quality of the overall library space based on the wishes and needs of users has a great impact on increasing the use of library facilities. Therefore, nowadays, the focus of architecture has shifted from being designer-oriented to being user-oriented and the space is not only responsive to functions but also to the users' emotions (Cho & Kim, 2017).

Although several studies have been done on the physical characteristics of the architectural space of academic libraries in other countries, the lack of identification and evaluation of architectural criteria to improve the quality of the environment in Iranian academic libraries is evident and the physical criteria dependence on the socio-cultural

characteristics in each region forms the question of the present research. Paying attention to the students' expectations from the study space in academic libraries provides wider horizons for architects, environment designers, and planners when facing the problem of the architectural design of academic libraries. As the behaviour of users, their expectations, and how to fulfil their needs and wants in academic libraries are cultural and context-oriented issues, the present research aimed to study and review the studies conducted in this regard and present an architectural interpretation of the pattern of usage and preferences of users in Iranian academic libraries to improve the functional desirability and physical quality of them (Fig. 1). Considering the financial and time constraints governing most architectural projects, identifying and prioritizing criteria can help directors, planners, architects, and environmental designers to take more appropriate decisions.

Theoretical Framework

The concept of quality indicates the condition of an object or a phenomenon so that it expresses its main, objective, and tangible features as a relative issue. Of course, it has a special emotional and intellectual impact on humans (Pakzad, 2020, 49). Due to the spatial nature of architecture, quality can be considered as having a special relationship with a place . This means that an architectural design must consider surrounding buildings and the place (the site of the project) while considering the main plan to achieve a meaningful relationship between the work and its context (Rönn, 2011). Spatial qualities are dependent on the proportions formed by the geometric relationships in the body (Pakzad, 2010). Therefore, factors such as form, size, the geometry of space, numerical proportions between its dimensions, and the distance between components lead to the formation of spatial qualities (Ghaffari, Mirgholami & Shafaei, 2021). Architectural quality leads to the integration of function (spatial organization), building technique (climate regulations), and aesthetic principles (Fronczek-Munter, 2011). According to Vitruvius, aesthetics is considered one of the main qualities of architecture. His definition of architecture is based on the three elements of beauty, utility, and firmness that are known today as form, function, and construction (Uzunoglu, 2012). Therefore, the desirability of

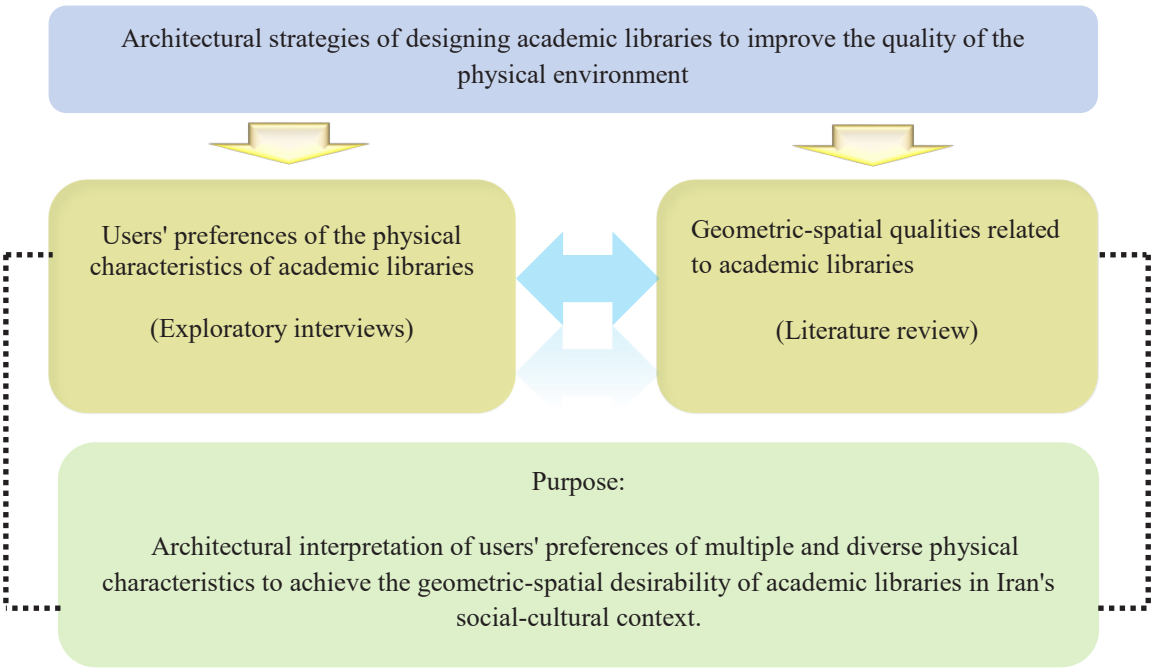


Fig. 1. The graph of the research process. Source: Authors.

the architectural space to improve the habitability of the environment for human activities is achieved by a specific range of architectural quality attributes in the design of the environment.

Research Background

From the start of the 20th century to the mid-1990s, the main objective of academic libraries was to select, organize, and curation of their collection (Becker, 2015; Holmgren & Spencer, 2014). It is argued that throughout this period, academic libraries were conceptualized as a repository of information (Sternheim & Bruijnzeels, 2013) that often served as the intellectual heart of the university; and the main role of academic libraries was to develop and make available a collection of scholarly resources. This role was considered so important that the reputation of an institution was determined by the size, breadth, and depth of its library's collection (Holmgren & Spencer, 2014). Although the collection plays a significant role, it is not the total of a library, and nowadays the function of libraries is more than just a building or a treasure house for books (Fallin, 2016). Technological developments, changes in policies, and financial pressures in the higher education sector have influenced universities to rethink the purpose and function of academic libraries. In the 21st century, with the development of multimedia, we are seeing a change in libraries from public places to complex and plural places. The library which was a place to collect books has become a place for users' communication and interaction (Lim & Ko, 2014). The study by Applegate (2009) has also shown that users prefer to use group study halls for their study.

Dowler (1997, cited in Mark Powell, 2002) argued that a modern academic library is a "knowledge gateway" that provides a set of services and spaces for learning. These services include electronic access to information and services provided for access to and effective use of documents (Beard & Dale, 2010), a flexible physical space that enables student learning through the individual study space, a small group study space (Beard, Byles & Newland, 2009) and demonstration facilities.

In recent decades, user demands regarding the space of academic libraries have changed (Matthews & Walton, 2014) and the changes that have been significant during the last thirty years have also challenged the definitions of the academic library (Fallin, 2016). Significant changes have been made in interior architecture, new forms, colours, and spatial structures to find solutions for the best use of the space by the users. Thus, interior space planning and its design play an important role in the design process (Sufar, Talib, & Hambali, 2012). Additionally, various optimal planning can improve the user's behaviour and experience of space (Mathews & Soistmann, 2016). The study conducted by Holder and Lange (2014) shows that such space qualities as function, aesthetic appearance, furniture, geometry, and window view are considered when designing the space of academic libraries. As visual appeal in architectural spaces leads to attracting more users, aesthetic elements in an architectural space can be considered as one of the factors affecting the visual appeal of the space. Therefore, when creating an architectural work, designers and architects pay attention to the functional requirements of the building, which are one of the priorities of the design process, and always pay attention to the aesthetic values of the building (Kuh & Gonyea, 2015). In this way, while improving the quality of the space, the presence of users also increases.

Different researchers have studied various features of libraries. For example, the studies by Beard and Dale (2010) and Latimer (2011) indicated that the library should be flexible, compact, accessible, organized, facilitating, varied, comfortable, quiet, secure, and constant in the environment and there should be a focus on optimal energy consumption (Jankowska & Marcum, 2010). Heitsch and Holley (2011) also argued that the integrity and coherence of the library space can improve the quality of group study while providing comfort.

To satisfy the increasing demand for learning spaces, such spaces as cafés and classrooms (Harrop & Turpin, 2013) and group study areas (Dallis,

2016; Holder & Lange, 2014; Montgomery, 2014) are considered in the design of newly-built or renovated libraries. These changes in physical space are such that students sometimes cannot find a quiet space for study (DeClercq & Cranz, 2014). Hence, academic libraries have often turned into crowded and underused spaces. The problem of crowded and noisy spaces in libraries has reduced the efficiency of students' scientific activities compared to the quiet spaces and Cha and Kim (2015) found in their research that the main spatial choices of students concerning the library spaces were reduced noise level, less crowdedness, and comfort of furnishing. The quietness and the space free from noise are so important that the findings of the study by Holder and Lange (2014) also indicated that many students preferred to find a quiet space to study as soon as they entered the library. The study by Tasviri Qamsari (2009) also showed that more than 57.4% of the researchers who used the library and the research centre of the Jihad Agricultural Engineering Research Institute were dissatisfied with the lack of quietness caused by the lack of spatial separation between the study hall and the place where the employees conducted their daily activities in the library.

The study conducted by Hillman, Blackburn, Shamp, and Nunez (2017) showed that students can use flexible learning spaces and moveable desks and chairs to meet their needs, if necessary. Andrews et al. (2016) found in their research that the variety of furniture in the library space can increase significantly the level of user satisfaction with the space. The variety indicates that the furniture should be comfortable, flexible, relaxed, colourful, and cheerful.

Paying attention to creating multiple and diverse spatial qualities to achieve a desirable architectural space is of great importance. Volumetric diversity in the architectural form of libraries is one of the factors that create attractive spaces. The hierarchy of access to the entrance of a library's study hall organizes the functional relationships with other spaces while creating various visual effects and emphasizing the relative interconnection between the form and space (Mccabe & Kennedy, 2012, 255). Of course, diversity in the library can be realized in different ways, for example, the variety of study methods, the methods of delivering and carrying books, and even the library program (Chijioke, Roseline, & Emmanuel, 2011), which should be taken into account when planning for the architectural design of academic libraries.

Although providing a list of possible threats to academic libraries is tedious, due to the importance of ensuring safety and security, library administrators and staff should take action to reduce the factors disrupting library security (Fink, 2017).

McCabe and Kennedy (2013) referred to the aesthetic aspects of the library space as one of the six aspects in which the users are interested. The study by Andrews et al. (2016) also indicated that the beauty and cleanliness of the library environment increased its productivity while encouraging students to attend and use the study hall. If beauty is considered the correct and appropriate continuum of innovation-familiarity duality in an object or a phenomenon (Pakzad, 2020, 384), such features as visual complexity related to the variety of dimensions, symmetry of form in complex abstract patterns, and color with the highest impact on aesthetic preferences (Jennatha & Nidhish, 2015), which are used harmoniously, integrated, and in a balanced form (Ojennus & Watts, 2017), can be pleasant and desirable for the user of the building, and of course, such a condition confirms the degrees of beauty.

Numerous studies have categorized students' needs in a library space under such common themes as more natural light in the reading room, larger and more desks, and more chairs (Andrews et al., 2016; DeClercq & Cranz, 2014; Khoo, Rozaklis, Hall & Kusunoki, 2016; Montgomery, 2014). Therefore, how to use daylight should be considered from the beginning of the building design planning (Benjamin, 1981, 56). The quality of daylight improves the physical and psychological environment while providing visual

comfort for activities performed by human vision. Daylight quality brings not only a sense of pleasure to the architectural space, but also differences in daylight and its versatile visual aspects enhance light quality in the architectural space (Hourani & Hammad, 2012). It was also found in the research conducted by DeClercq and Cranz (2014) and Foster and Gibbons (2007) that students preferred to sit near the windows of the study hall of academic libraries to receive daylight while studying. Therefore, considering the significant correlation between lighting and library users' performance, lighting design based on scientific indicators is necessary to optimize the efficiency of users' activities (Akanmu, Nunayon, & Eboson, 2021). Lighting is so vital for libraries that the low level of daylight inside the building leads to a sharp drop in the amount of lighting needed in the space, endangers the health of the eyes, and may cause various visual complications and discomforts such as eye strain, eye irritation, blurred vision, and headache (Akanmu et al., 2021). Therefore, it is necessary to consider the technical specifications of lighting for each of the parts of the library such as the reading room, digital reading room, lecture hall, book storage, and other departments. Additionally, in the research by Ojennus and Watts (2017), the library users were interested in using a variety of artificial lights by equipping study tables with desk lamps to adjust manually the amount of light required. Daylight should be used in academic libraries to prevent glare and eye strain while providing lighting for various functions. Additionally, qualitative aspects of daylight activate the dynamics of an architectural space so strongly that the quality of daylight as a design element affecting the enhancement of the aesthetic and psychological aspects of an architectural space leads to a rich diversity of experiences of space perception (McCabe & Kennedy, 2012, 63).

Whenever it comes to light in architecture, the type and quality of colour are also considered by designers. Colour is considered a major element in interior design and has a significant impact on improving the quality of physical learning environments. Colours and certain patterns directly affect the health, spirit, emotions, behaviour, and performance of learners depending on their culture, age, gender, and the subject being studied (Daggett, Cobble, & Gertel, 2008).

Not only is colour one of the effective components of interior design, but also it is a context-dependent concept (Ulusoy, Olguntürk, & Aslanoğlu, 2021). It can create a system of order in an architectural space while making it possible to recognize the important and non-important elements in the surrounding environment. The undeniable impact of colour on the environment, especially the space of libraries, can also be seen in human sensory receptors and preferences. The study by Jennatha and Nidhish (2015) also indicated that if the colour is combined with the physical components, form, and geometry of the library, it leads to the improvement of the quality of the library space. It reduces the uniformity of the space and enhances the perception of the viewer. However, calming the space and creating quietness, which is among the requirements in study halls, the use of light green colour can improve the attentiveness and concentration of users (Mahnke, 1996). On the other hand, observing directly the colours used in the interior spaces of 20 academic libraries in Isfahan, Cheshmeh Sohrabi, Rahim Salmani & Rahim Salmani (2011) found in their research that white colour was the most used colour in libraries, followed by cream colour as the most frequently used colour. As white and cream are among neutral colours, psychologists' analysis indicates that these two colours are a suitable choice for creating more concentration in the interior spaces of libraries. Libraries also need to be equipped with facilities to provide the best conditions for studying. This equipment should be located in such a way that users are not confused. Planning all stories in the same way and creating well-equipped zones such as web browsing zones, group work, resources, and recreation are the best ways to create various and user-friendly environments for users (Juhnevica & Udre, 2010). Developments in computer technology have contributed mainly to changes in library spaces (Becker, 2015).

Academic libraries are repositories of data and information for research, education, display, and

collection. Hence, quick and easy access to the contents of a library is another issue that must be addressed by architecture. This issue becomes even more important when we become aware of the fact that about 75% to 80% of students in the US suffer from library phobia. This phobia is due to the lack of facility directions when needed (Tzeng & Wang, 2011). Behpour and Siamak (2013) also examined the spatial organization of the National Library of Iran in terms of distance and proximity of spaces by analyzing the movement path of users. They explained the effect of architectural design strategies on saving the time spent by users in the interior space and compared the study case to the ideal situation in terms of what is called spatial dispersion. In other words, if the accessibility to the existing and frequently used functions in the National Library of Iran is not designed ideally or even is intervened inappropriately after the completion of the building construction, users may be confused and prefer to avoid such activities as matching two documents in two different sections, requesting a specific book, or researching a document.

The study by Adamu (2017) showed that such factors as the desired quality of access to IT services, e-resources, and internet services, the number of computers in the library, and the environmental factors such as the cleanliness of the library environment, the lighting of the library building, the arrangement of seats in the study hall were among the factors affecting the satisfaction of undergraduate students in Yusuf Maitama Sule University library. Listing 5 major categories of standards affecting digital libraries, Nowrozi and Jafarifar (2014) also emphasized the decisive role of standards architecture in the future design of digital libraries in the 21st century. In the research by Asadi and Mahdigholi (2016), it was recognized that the future of academic libraries depends on the formation of information commons that is guided by information management and the intelligentization of services. If this is achieved, not only fast and free access to electronic and digital information sources and scientific research be provided but also cooperative learning is encouraged with the presence of knowledgeable and skilled employees. The components forming an architectural space such as an academic library should also be able to respond to the changing needs of the scientific community. Therefore, considering the impact of various social and cultural aspects on the multiplicity and variety of people's demands and expectations from the architectural space, it seems necessary to explain the qualitative criteria of the architectural space of the study hall in the academic libraries in Tehran province. According to what was extracted from the literature review, 16 indicators that affect the quality of a desirable library have been listed in Table 1.

Therefore, the current research aims to identify the most important components affecting the quality of the architectural space of Iranian academic libraries to maximize the attendance of students.

Research Method

The current research was conducted using a qualitative approach and grounded theory method. The conceptual framework of the grounded theory depends more on the data and constructs collected from the actors than the previous studies. It means that this theory is data-oriented and avoids the mere test of analogical hypotheses. In this regard, the researcher tries to discover the dominant processes in the social context from the subjects' point of view and does not limit his research to the mere explanation of the data and units under investigation (Mohammadpour, 2013). According to this method, a purposeful non-random sampling method and semi-structured interviews were used to collect data in the present research. The research population consisted of 14 students and staff, both male and female, aged 18- 45 years, who were studying or working in the universities of Tehran, Shahid Beheshti,Iran University of Science and Technology, Tarbiat Modares, and Allameh Tabataba'i and used the space of the central library of their university. The interview with each of the students and staff lasted approximately 50 minutes. When theoretical saturation was achieved, data coding was done in three open, axial, and selective stages. The demographic information of the interviewees has been presented in Table 2. Additionally, Table 3 shows the main geometric-spatial features of the libraries from which the interviewees were selected.

Table 1. The indicators of the quality of a desirable library. Source: Authors.

		Indicators of a desirable library	References
1	Spatial geometric features	Flexibility	(Hillman et al., 2017), (Dallis, 2016), (Beard & Dale, 2010); (Latimer, 2011), (Beard et al., 2009), (Feizi et al., 2016), (Powell, 2002)
		Coherence (integrity)	(McCabe & Kennedy, 2012), (Heitsch & Holley, 2011), (Latimer, 2011), (Beard & Dale, 2010)
		Accessibility	(Holmgren & Spencer, 2014), (Tzeng & Wang ,2011), (Latimer, 2011), (Beard & Dale, 2010), (Behpour & Siamak, 2013)
		Geometry	(Holder & Lange, 2014), (Jennath & Nidhish, 2015)
2	Human environmental comfort	Lighting	(Ojennus & Watts, 2017), (Andrews et al., 2016), (DeClercq & Cranz, 2014), (İmamoğlu, & Gürel, 2016), (Khoo et al., 2016), (Montgomery, 2014), (Vaska et al., 2009), (Benjamin,1981), (Mccabe& Kennedy, 2012), (Hourani& Hammad, 2012), (Akanmu, et al., 2021), (Foster & Gibbons, 2007), (Feizi et al., 2016)
		Comfortability	(Ojennus & Watts, 2017), (Cha & Kim, 2015), (Latimer, 2011), (Andrews et al., 2016), (Beard & Dale, 2010)
		Safety and Security	(Fink, 2017), (Latimer, 2011), (Beard & Dale, 2010)
		Being constant in the environment and environmentally suitable	(Adam, 2017), (Beard & Dale, 2010), (Latimer, 2011), (Jankowska & Marcum, 2010)
		Silence and quietness	(DeClercq & Cranz, 2014), (Cha & Kim, 2015), (Latimer, 2011) (Beard & Dale, 2010), (Holder & Lange, 2014), (Mahnke, 1996), (Heitsch & Holley, 2011), (Tasviri Qamsari, 2099), (Feizi et al., 2016)
3	Equipment	Furniture	(Hillman et al., 2017), (Dallis, 2016), (Andrews et al., 2016), (Holder & Lange, 2014), (Cha & Kim, 2015), (Feizi et al., 2016)
		Extendibility and suitability for information technology	(Becker, 2015), (Latimer, 2011), (Powell, 2002), (Juhņeviča & Ūdre, 2010), (Adam, 2017), (Nowrozi & Jafarifar, 2014), (Nazarpour, Norouzian Maliki, & Ahmadi, 2019)
4	Functional aspects	Being efficient and economic	(Jankowska & Marcum, 2010)
		Being organized and interactive	(Mathews & Soistmann, 2016), (Latimer, 2011), (Spencer & Watstein, 2017), (Beard & Dale, 2010)
5	Aesthetic aspects	Attractiveness and beauty	(McCabe& Kennedy, 2012), (Holder & Lange, 2014), (Cho & Kim, 2017), (Ojennus & Watts, 2017)
		Color	(Jennatha & Nidhish, 2015), (Daggett et al., 2008), (Ulusoy et al., 2021), (Mahnke, 1996), (Cheshmeh Sohrabi, Rahim Salmani & Rahim Salmani, 2011)
		Variety	(McCabe& Kennedy, 2012), (Beard & Dale, 2010), (Latimer, 2011)

Results

After conducting interviews and analyzing and classifying 147 data from the interview, 33 propositions were conceptualized as open codes, and axial codes were obtained from 20 main categories, including electrical facilities and the Internet on desks, flexible space for group activities, air conditioning and thermal comfort, desk and seat materials, visual views in the outside space, visual views in the inside space, digital services, accessibility and layout, access to the Internet, compliance with ergonomics in furniture, vegetation and landscape in the outside space, vegetation and landscape in the inside space, quietness and enabling concentration, spatial hierarchy, window function and dimensions, environmental graphics, enclosure and continuity, how long the study hall is open, light, light source (light colour), and geometry and height. Additionally, 5 cores including leisure time and relaxation, environmental comfort, spatial organization, quality of furniture and shelving, and management and planning were recognized as selective codes from the qualitative data (Fig. 2).

Discussion

Among the codes extracted from the interviews, "leisure time and relaxation", "environmental

Table 2. Demographic information of interviewees. Source: Authors.

Specifications		Description	
Users	Age	18<A<45	18<A<45
	Gender	6 men	8 women
	Ethnicity	Iranian	Iranian
	Occupation	Undergraduate and Graduate Students and Staff	

comfort", "spatial organization", "quality of furniture and shelving", and "management and planning" need more than other codes to adopt architectural ideas to improve the desirability of the quality of the space of academic libraries. The findings of the study by Cha and Kim (2015) also indicate that parts of the library that have better spatial qualities generally attract more students.In recent years, with the widespread dominance of information technology in the expansion of digital information, the goals of libraries have also been developed following scientific achievements. Sheikh (2015) argued that academic libraries are required to change their services from the traditional method to the modern one to respond to future needs. While redesigning services, resources, and physical space, these changes lead to the formation of an inclusive information commons. Oliveira (2016) also argued that the development of the education system has currently changed its paradigm from individual learning to cooperative learning and group interaction. Accordingly, Bilandzic and Foth (2013) challenged academic libraries to change their spatial planning to respond to the changing needs of the university and facilitate teaching and learning. Therefore, the current research describes the architectural strategies of the design of academic libraries as follows:

- **Leisure time and relaxation**

Although the study by Cha and Kim (2015) indicates that the aesthetic appearance has the lowest rank (3.38) among the 18 main architectural features of the library spaces, the findings of the present research demonstrated that designing some parts in the vicinity of the study halls that provides visual views and using vegetation and landscape in the interior and exterior spaces can be effective in providing spaces for the leisure time and the relaxation of users after a long study (Fig. 5). The research by Asadi and Mahdigholi (2015) on the current conditions of academic libraries considered cafeterias and relaxation spaces as the centre of attention of busy students. In general, the visual views, vegetation, and landscape include the following two main parts. The visual desirability of diverse views in the interior

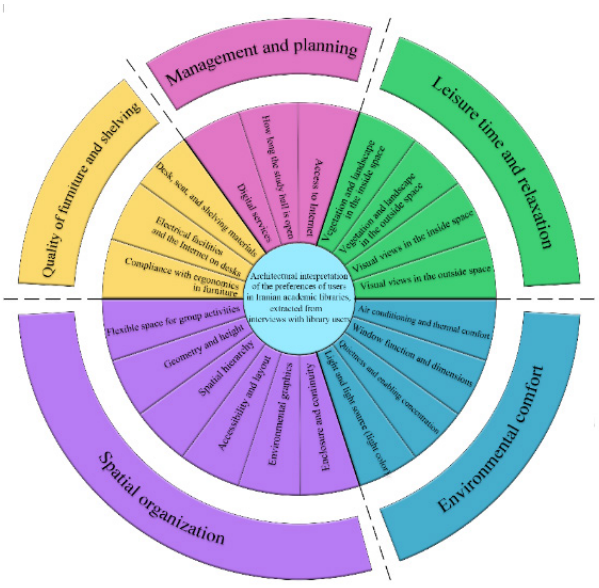
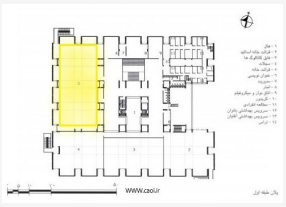
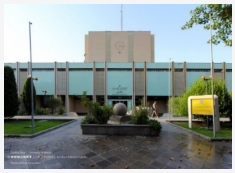
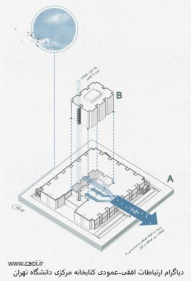
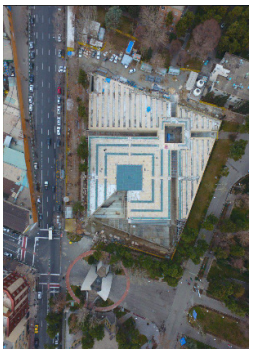
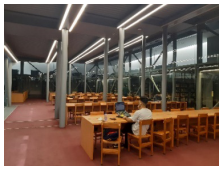
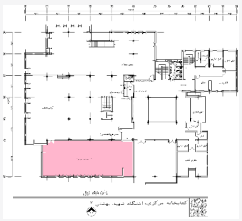
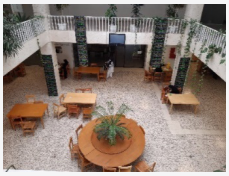
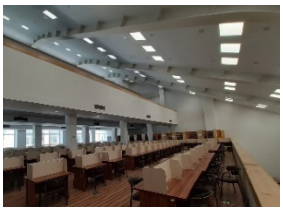
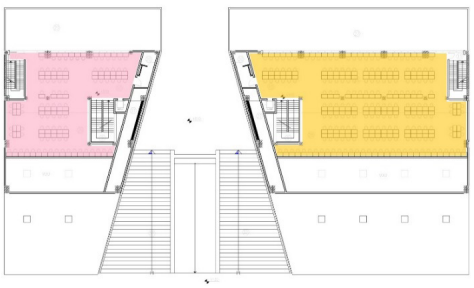
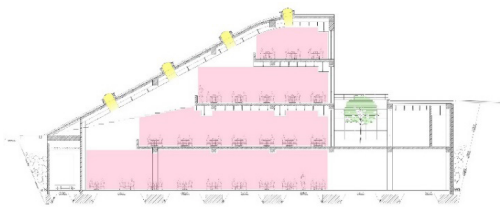


Fig. 2. Architectural interpretation of the preferences of users in Iranian academic libraries, extracted from interviews with library users. Source: Authors.

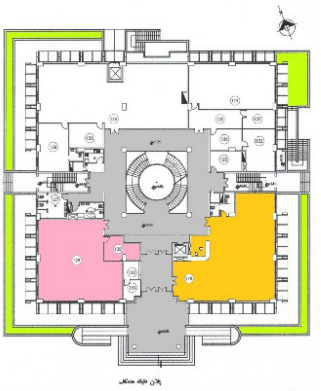
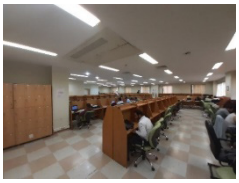
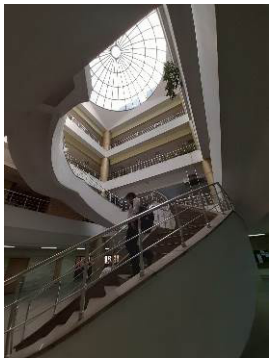
Table 3. Architectural information of studied libraries.Source: Authors.

No.	Title	Interviewees		Architectural features	Figures	
		Male	Female			
1	Central Library of University of Tehran. Source: www. Caoir.ir	1	2	1. The general geometry of the building is in the form of two cubic volumes with 4 and 8 floors. 2. Access to the building from the north side by crossing a bridge. 3. Elements of vertical communication in the interior space include an elevator and staircase in the central core of the building. 4. Maximum coordination between structural elements and spatial elements by the modular organization. 5. Establishment of the study hall in the southwest front while observing the access hierarchy. 6. Deep windows to control western light	 	 
2	Central Library of Iran University of Science and Technology. Source: Scientific Documentation Center of Iran University of Science and Technology	1	2	1. Because two valuable buildings, the portal and the mosque of the Iran University of Science and Technology, are located in the vicinity of the project site, the main criterion for the design of the central library of this university was the establishment of the building at negative levels from the ground level. 2. The central core of the design, which is the location of the vertical communication elements (stairway and elevator), is a void in the middle of a cube, which has a view of the sky from the top and to the shelves on level -1 and the study hall in level -2 from the four sides. 3. On level -2, the study hall for women and men has been organized with glass partitions around the central core. 4. The lighting of the storage space and the central core is provided by skylights and a relatively wide glass surface above the entrance stairs.	 	 

Rest of table 3.

No.	Title	Interviewees		Architectural features	Figures
		Male	Female		
3	Central Library of Shahid Beheshti University. Source: Document Center of Shahid Beheshti University	2	1	1. Due to the establishment of the university site on the slope, it is possible to access the library lobby from the eastern front through the external stairs. 2. The east-west extension of the building has been organized on two floors. 3. The book storage is located on two floors with internal access on the north side. Additionally, the women's study hall is located on the upper floor receiving the south light. 4. On the ground floor, an open group study space has been combined with the lobby.	   
4	Central Library of Allameh Tabatabai University. Source: Document Center of Allameh Tabataba'i University	1	2	1. According to the topography, it is located on the northern side of the main site of the university, and the presence of green cover on the sloping roof emphasizes the theoretical foundations of sustainable architecture. 2. The study space for men and women is located in two east-west clusters with 8 study halls on 4 floors in the form of roofed balconies and the projections are such that the first floor can be seen from the level of the highest floor. 3. The administrative and internal department is independent of the study hall, which has created a more suitable space for the study hall in terms of quietness while separating the traffic of the administrative department. 4. The entrance, as a spatial joint, has created the connection between the men's and women's sections on the ground floor. 5. It is possible to take advantage of natural light by using all-around windows on the north side of the building and 134 skylights. 6. The library storage is located in the basement level.	   

Rest of table 3.

No.	Title	Interviewees		Architectural features	Figures
		Male	Female		
5	Central Library of Tarbiat Modares University. Source: Central Library of Tarbiat Modares University	1	1	1. The library spaces are organized with an inward pattern around a void. 2. The building is designed on four levels, including three floors on the ground level and one basement floor. 3. The men's study hall is located on the right side of the entrance and the women's study hall with a vestibule is located on the left side of the entrance. 4. Access to the floors through vertical connector elements includes a spiral staircase in the void and two elevators. As well as, escape stairs are installed on the east and west sides for crises. 5. The open-access book storage is on the third floor.	   

space of academic libraries can be achieved by the architectural design of physical elements reproducing desirable spatial geometric qualities. These qualities express the proportions between the elements of the space and the features resulting from these proportions. In other words, although the geometric features of the space include the dimensions, components, and the distance between the components of a space, the spatial qualities are dependent on the connections resulting from the geometrical relations, such as the proximity of physical elements, the order, separation, enclosure or continuity of the elements (Pakzad, 2020). For example, one of the types of proximity of physical elements in the interior is the design of spaces that are considered for leisure time after study. While providing functional desirability by using the capabilities, vertical openings such as terraces, windows, and doors with transparent coverings that overlook the vegetation and landscape in the inside and outside spaces of the academic libraries can be considered a suitable manifestation of the desirable geometrical qualities providing a space for leisure time and relaxation of the users (Fig. 3). Since the correct arrangement of furniture to enjoy light and view without obstacles from the sides and not behind leads to functional desirability, it seems that the efficiency can be improved and a better quality of space can be achieved by changing the arrangement of furniture considered for students in Fig. 3. Another example that shows the enclosure and continuity as one of the factors formed by geometric-spatial relations can be the design of passageways in the interior space that surrounds horizontal openings such as voids (Fig. 4). With such a quality of the space, it is expected that successive views of a range of levels established at various heights, which led to a novel combination of forms by a coherent organization of physical elements, provide the continuity of the experience of spatial diversity for the users of the academic libraries.

It should be noted that the above-mentioned are examples of leisure time and relaxation. Certainly, in the study hall, the control of privacy should be emphasized to provide visual comfort in the environment and maximum concentration for users while studying. Massis (2012) also indicated that although academic libraries make the necessary efforts to create more attractive and comfortable spaces in line with the new technological requirements, learning habits, social and collaborative environments, and contemporary education, the need for a quiet space to ensure the concentration of users is still the priority of the architecture of study halls in libraries.

- **Environmental comfort**

The findings of the current research indicate that factors such as quietness and spaces enabling concentration, window function and dimensions, air conditioning and thermal comfort, and light and light source (light colour) are effective in providing environmental comfort for users (Fig. 10). Sound generation and soundproofing are the major activities of architectural acoustics where the first one deals with the positive aspects of the presence of sound in architectural space and the latter deals with the reduction of the negative effects of unwanted sounds (noise) in the space. Intuitively, it is understandable that a noise-free environment is necessary for effective learning and study. Students choose the library to study in a quiet and peaceful space where the available quietness and tranquillity prevent them from being distracted (Goodnight & Jeitner, 2016). The study by Cha and Kim (2015) showed that noise level and crowdedness were the main determinants of students' spatial choices concerning library spaces. In the study hall of academic libraries, where the provision of silence and quietness is one of the inevitable necessities, the use of floor absorbers seems to play an important role in reducing noise (unwanted sounds) (Figs. 6 & 7). There must be serious control over interactions and disturbances in the sub-spaces formed in the study hall. Therefore, the passage corridors of the study hall with low light and low ceilings can be effective in the quietness of the study hall during the traffic of users. Regarding the measurement of illumination in libraries with irregular geometric areas, the study by Majidi, Azimi Pirsaraei, and Ajami (2009) indicated that in cases where the existing patterns cannot be used to determine the illumination in environments with irregular geometric areas, using GIS method has a very high ability to interpolate between known points, according to which the illumination quantities for a set of stations in such environments can be determined. With the help of this method, it is possible to show the distribution of the illumination in the irregular geometric library halls in the form of isolux curves.

Ojennus and Watts (2017) also found that due to the long period of the presence of people, the availability of more space in the study halls has an effective role in providing more silence and making more concentration possible for users (Fig. 8). It should

Fig. 3. Women's study hall of the central library of Allameh Tabataba'i University. Overlooking the vegetation and landscape of the outside environment. Source: Author's

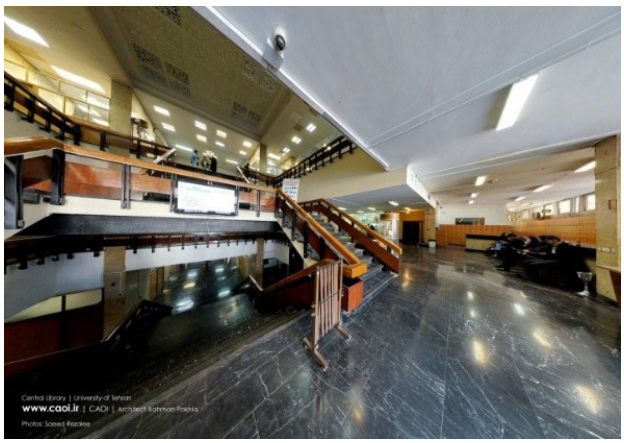


Fig. 4. Passage corridors in the vicinity of a void. Central Library of the University of Tehran. Source: WWW. Caoi.ir

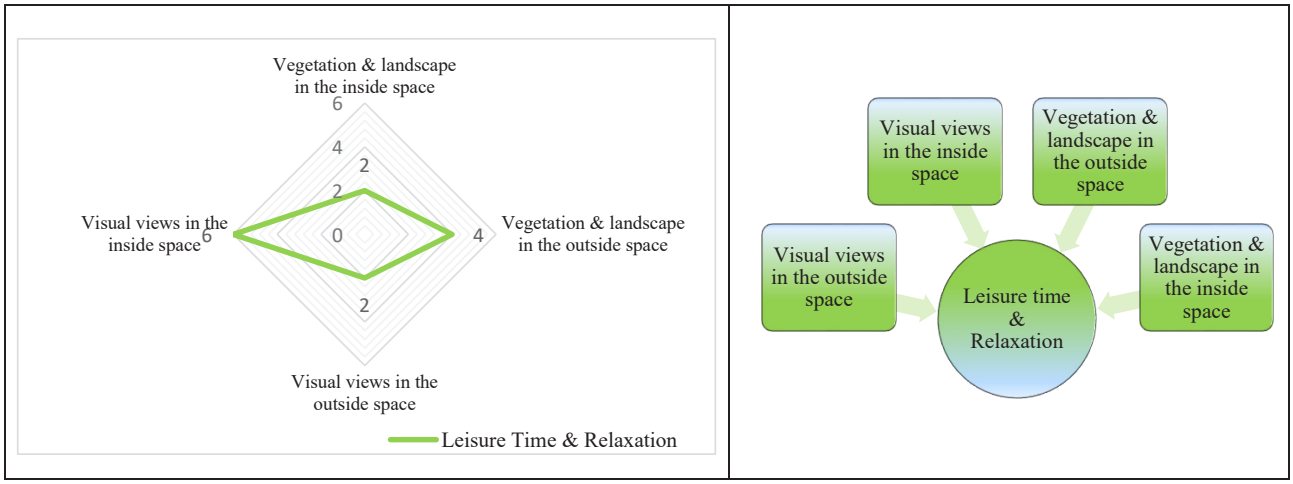


Fig. 5. Factors affecting the provision of leisure time and relaxation. Source: Authors.

Fig. 6. Floor absorbers. Central Library of Allameh Tabatabai University. Source: Author's Archive..

Fig. 7. Floor absorbers. Central Library of Iran University of Science and Technology. Source: Author's Archive..

be noted that although the strategy used to design the interior spaces in academic libraries may help to provide the required light by wide and large glass surfaces that cause daylight to enter the interior spaces, the repair, maintenance, and cleanliness of transparent surfaces lead to additional costs for libraries (Fig. 9). The findings of the present research emphasize air conditioning and air movement in accordance with the thermal comfort of users in the cold and hot seasons of the year and the occurrence of special conditions such as epidemics and related health considerations such as social distancing. The studies by Foster and Gibbons (2007), Gfeller, Butterfield-Nagy, and Grignon (2011), and Twait (2009) also considered the thermal comfort of the users of academic libraries as one of the main factors providing human environmental comfort, which can be achieved by providing the mechanical cooling-heating systems, air conditioning, and natural air movement. As proper natural ventilation is one of the architectural requirements of the interior space of the libraries, the appropriate placement of opening windows in the building for proper natural ventilation is considered one of the important design criteria (Ayoosu, Lim, Leng, Aule, Gabriel, Malaysia, & Nigeria, 2020). The quality of daylight, as one of the architectural design criteria, can also affect the richness of various perceptual and sensory qualities of academic libraries (McCabe & Kennedy, 2012, 261). The main purpose of window design in the building is to provide daylight, natural ventilation, and attractive visual views. According to the observations of the researchers of the present research, as the users of academic libraries spend most of their time in the

Fig. 8. The vast space in the men's and women's study hall of the Central Library of the Iran University of Science and Technology. Source: Scientific Documentation Center of Iran University of Science and Technology.

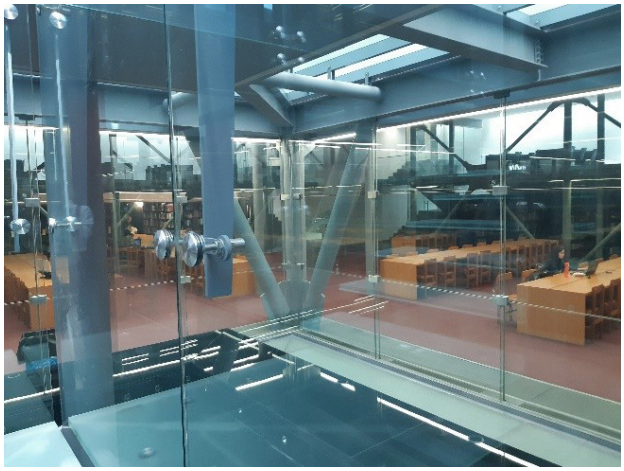


Fig. 9. Glass partitions. Central Library of Iran University of Science and Technology. Source: Author's Archive..

library for studying, providing enough daylight at all hours of the day can be the most important goal related to providing light in the library. The study by Lahouti, Qanbaran, and Moradi (2014) also referred to daylight as one of the factors affecting the level of satisfaction of library users in the city of Ilam. Therefore, the natural light that emits from the windows into the space not only is a suitable source of lighting but also is an essential factor in the overall success of the library design (Omar, et al., 2018). Moreover, it is also effective in providing desirable views and reducing the eye strain of students. Ugwuanyi et al. (2011) also indicated that quiet space with adequate lighting makes it easier for users to concentrate in study halls than a place that is always noisy and dimly lit. It seems that if wide glass surfaces are designed and implemented on sides of the academic library building that are exposed to more daylight, including the south, east, and west facades or ceiling skylights are used without the installation of reflectors and canopies, there will be users complaints and dissatisfaction with the glare or radiant heat in the environment. Therefore, the location and the area of the windows and light-transmitting openings should be calculated and analyzed in terms of a thermal and visual comfort considering the geographical directions and the climatic characteristics of the site.

- **Spatial organization**

Organizing and structuring the subspaces within the formal bodies and allocating space to various functions are conducted by the planning technique. The research by Taavoni, Soltani, Hariri & Mehrad (2011) indicated that the interior design of the building and the relationships between the different parts of the library should be based on the logic of the library's workflow and have maximum efficiency to reduce the management costs while observing the principle of simplicity of its administration and the flexibility of rearrangement of functions. The composition and layout of the subspaces of an academic library, which are designed based on a variety of form-space organizations, seem to be managed by the function, proximity, and pathway. The results of this research also indicate that zoning the study space, especially in the women's section, for relative enclosure and respecting simultaneously the spatial continuity in the entire study hall complex, leads to more functional desirability. Thus, achieving the privacy of the study space with the ability to personalize the space is among the preferences of academic library users. Meanwhile, the research by Oliveira (2016) investigated the preferences of both male and female students who were users of the James White Library regarding the four types of spatial zoning, including closed individual study space, open individual study space, open group study space, and interactive learning space. The research by Aazem (2017) also referred to the possibility of organizing one-person, two-person,

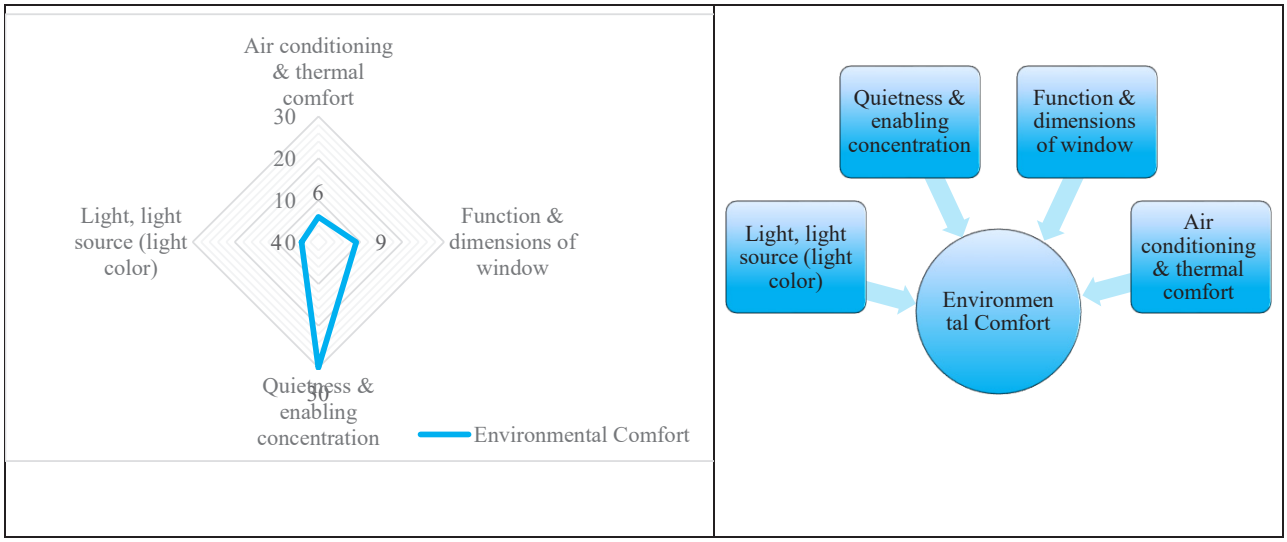


Fig. 10. Factors affecting the environmental comfort. Source: Authors.

and four-person tables in the study hall of academic libraries as a valuable feature of the built environment that meets the needs and preferences of a wider range of users (Figs. 11 & 12). It can be challenging to find ways in libraries. However, few studies conducted on wayfinding have been related to libraries (Eaton, Vocino & Taylor, 1993). Additionally, the space readability, the ease of movement from one point to another in a plan to access the different components of the space through the geometry of the plan and the vertical access elements, and the observation of the principle of hierarchy in the space of academic libraries lead to designing a straightforward circulation, making building components coherent, both on the surface and in the height. In addition to facilitating the overall perception of the users of architectural space, the principle of adaptation for physically disabled people can also be observed. The study by Taavoni (1998) also represented a list of the requirements of a library interior design, including short distances for transporting library resources, linear organization of library corridors, and avoidance of creating unnecessary obstacles such as stairs or breaking and changing directions to increase the functional desirability of the space. Therefore, the principle of simplicity and legibility of the path in the open library storage is very important to help newcomers and unfamiliar users easily access the resources they need (Figs. 13 & 14). In general, convenient and easy access to the library building is considered an important advantage (Fig. 15).

Environmental graphics are considered useful tools for designing spaces and creating identity (Torbati, 2018). While adjusting the human connection with the environment, the environmental graphic seems to eliminate the unnecessary and inappropriate points in the space and highlight its important points to make the architectural space more readable. Citing Khoo et al. (2016), Given and Leckie (2003) also stated that the group rooms in libraries cause users' complaints and dissatisfaction with noise. However, the observance of requirements contained in the National Building Regulations to prevent the transmission of sound as well as the spatial hierarchy in the placement of functions make it possible to provide a group study space for students while activating the flexibility of the space through furniture. Lange, Miller-Nesbitt, and Severson (2016) also argued that the noise in the study halls is not necessarily due to a large number of students, but the spaces adjacent to the study hall such as stairs and corridors and group rooms can contribute to producing noise.

- **Quality of furniture and shelving**

Fixed and movable equipment, furniture, and appliances are an integral part of the internal architecture of a library. The quality of the furniture and the optimal shelving depends on factors such as efficiency, durability,

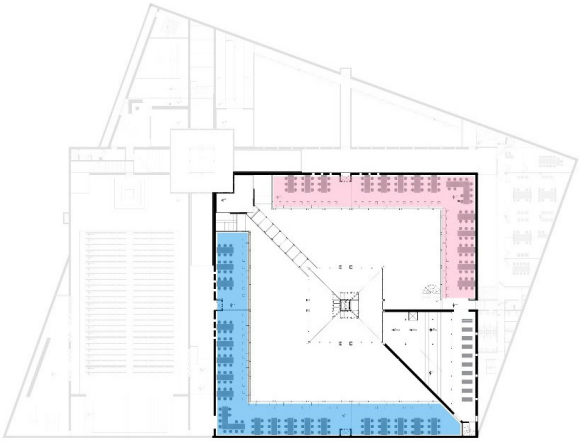


Fig. 11. Open group study space at the mezzanine level of the central library of Iran University of Science and Technology. Source: Scientific Documentation Center of Iran University of Science and Technology

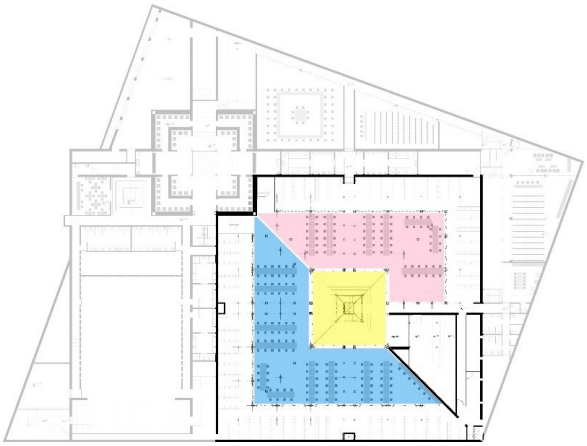


Fig. 12. Lack of diversity in furniture arrangement. Central Library of Iran University of Science and Technology. Source: Scientific Documentation Center of Iran University of Science and Technology.

strength, elegance, harmony, ease of movement, ease of maintenance, adaptability, changeability, relative resistance to water and fire, the least amount of noise caused by displacement, structural integrity, stability, aesthetic features, and attention to user ergonomics (Fig. 19) (Taavoni, 1998). Therefore, suitable and flexible furniture in the library can lead to significant differences in the attractiveness and functionality of the library spaces (Choy & Goh, 2016). In a similar research, Cunningham and Tabur (2012) also emphasized the need for large and comfortable desks in the library space. It seems that the availability of such equipment as the dimmable desk lamp to adjust the optimal amount of light required by the user, the power outlet, and the Internet cable on the furniture is of great importance to improve the functional desirability of the study hall. Flexible furniture in compliance with the ergonomics of the body, such as chair handles with the ability to change and move, the possibility of changing the height of the chairs, or the possibility of changing the height and angle of the study table are among the preferences of users in academic libraries. (Figs. 17 & 18). Providing closets for users in a suitable place to keep their equipment and devices while studying creates a more suitable environment in the space of academic libraries. In addition, the application of suitable fittings in the library shelves to change the height of the shelves makes it easier for the users to access the books on the higher floors. In general, furniture and fixed and movable equipment in libraries should be in relative harmony with other factors

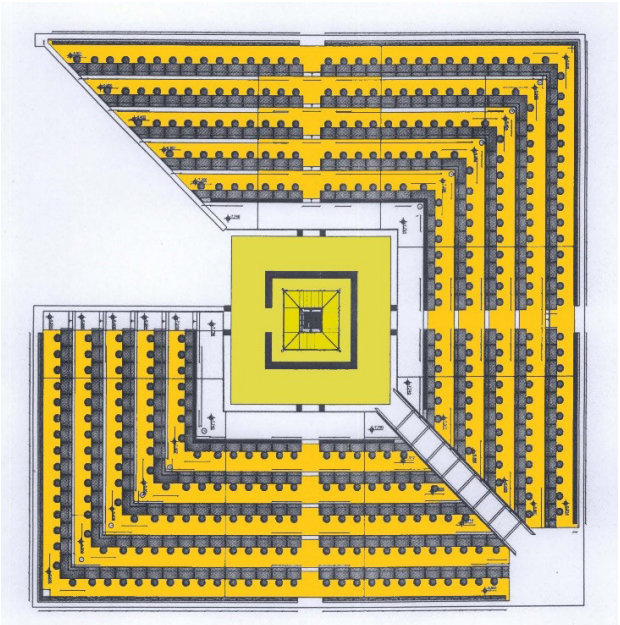


Fig. 13. View of open storage (stepped) of Central Library of Iran University of Science and Technology. Source: Scientific Documentation Center of Iran University of Science and Technology.

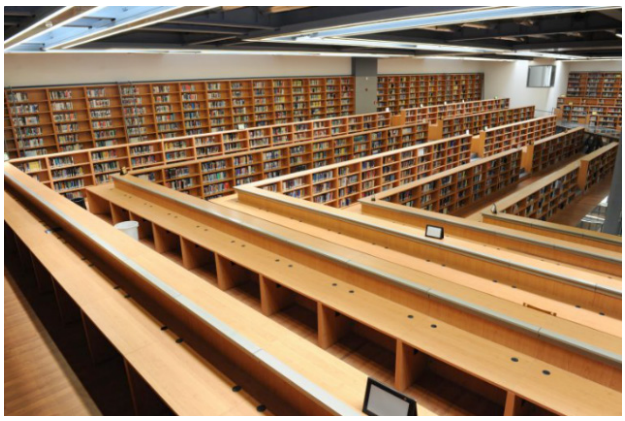


Fig. 14. Open storage plan (stepped) of Central Library of Iran University of Science and Technology. Source: Scientific Documentation.

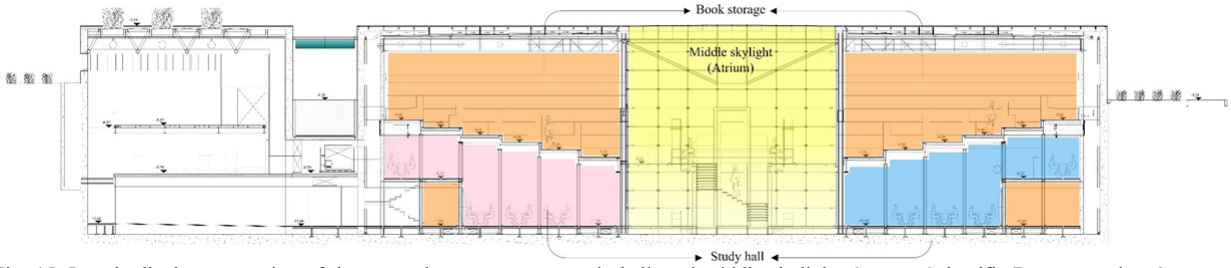


Fig. 15. Longitudinal cross-section of the stepped storage space, study hall, and middle skylight. Source: Scientific Documentation Center of Iran University of Science and Technology.

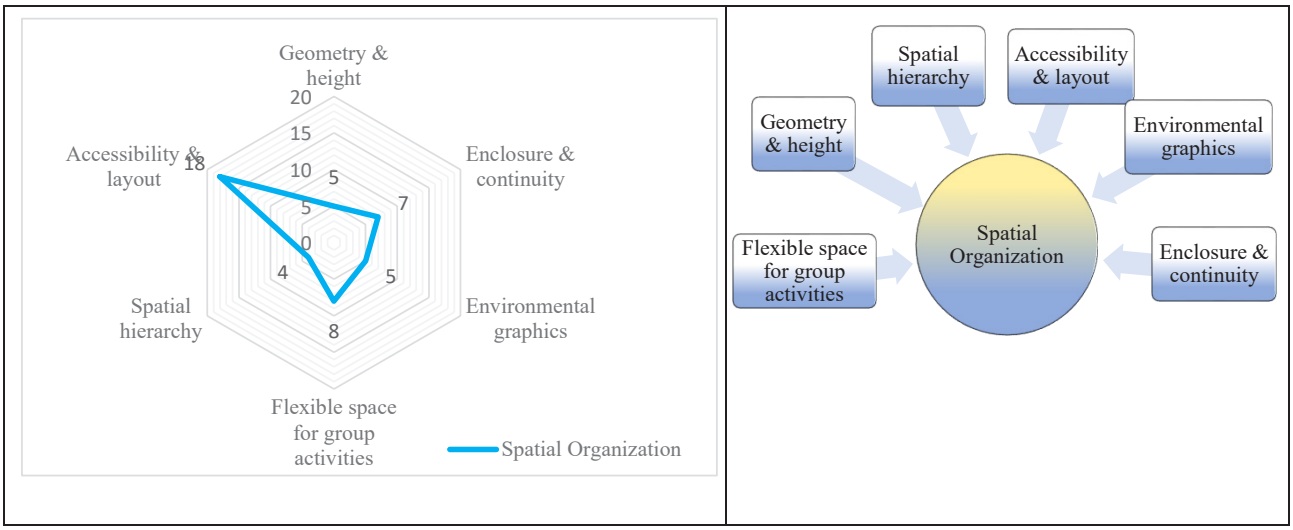


Fig. 16. Factors affecting the spatial organization. Source: Authors.

such as colour, texture, and architectural features of the space (Aazem, 2007).

- **Management and planning**

Management, control, and support of the plans ensure the correct implementation of all affairs that were discussed in the previous parts. It should be noted that the services provided in the library such as welfare facilities or software infrastructure support (Nazarpour, Noroozian Maleki, & Ahmadi, 2019), printing and digital services, wireless networks and the Internet, virtual references, remote access and electronic resources (Asadi & Mehdigholi, 2015), proper timing of returning books to the bookshelves, establishing order to provide environmental comfort, and cleaning the spaces should be managed correctly, and the lack of proper management of the mentioned affairs causes disruption and inefficiency. On the other hand, Understanding the preferences of users for library facilities and redesigning them to suit their needs are of great importance for planning effectively the space (Given & Archibald, 2015). Due to the long presence of students in the study hall, taking management decisions to support and plan the day and night conditions of the study hall of academic libraries makes it possible for students to use maximally the library space at different hours of the day while increasing the efficiency considering the preferences of the library staff (Fig. 20).

The relationship between the indicators obtained from the literature review and the codes extracted from the interviews has been shown in Table 4. According to this table, such propositions as environmental graphics and enclosure and continuity under spatial organization are the ones that could not be found in the literature review. Therefore, the mentioned codes confirm that the users' preferences for the architecture of academic libraries as a cultural and context-oriented issue require more attention from designers, architects, and environmental planners to the architectural components in the design process to provide maximum efficiency and presence of users while emphasizing on improving the physical quality of the environment.

Fig. 17. Flexible chairs in the study hall of the central library of Tarbiat Modares University. Source: Author's Archive.

Fig. 18. Variety in furniture arrangement. Temporary study hall of the central library of Tarbiat Modares.

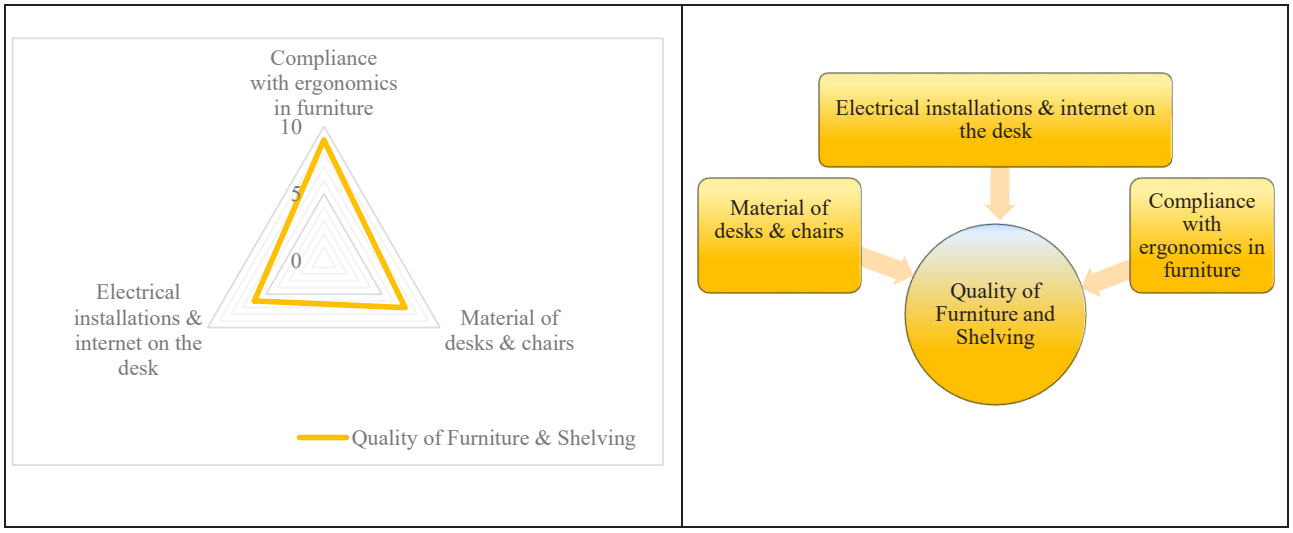


Fig. 19. Factors affecting the quality of furniture and shelving. Source: Authors.

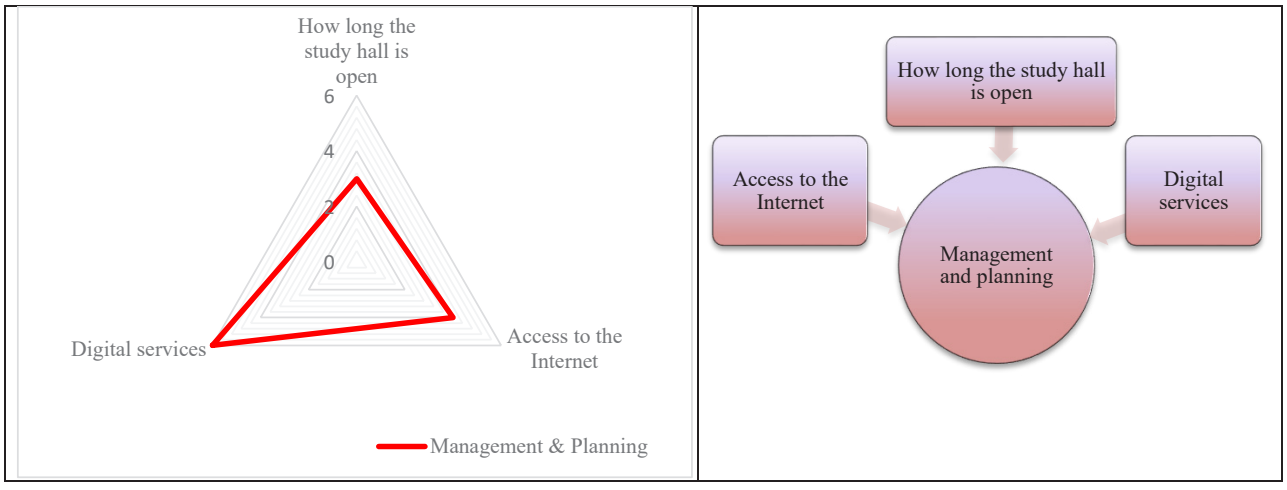


Fig. 20. Factors affecting management and planning. Source: Authors.

Table 4. The relationship between the indicators obtained from the literature review and the codes extracted from the interviews . Source: Authors.
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			Indicators obtained from the literature review														
				Spatial & geometric features			Human environmental comfort conditions					Equipment		Functional aspects		Aesthetic aspects	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Flexibility	Integrity and coherence	Accessibility	Geometry	Lighting	Comfortability	Safety and Security	Being constant in the environment and environmentally suitable	Quietness and silence	Furniture	Extendibility and suitability for information technology	Being cost-effective	Being organized and interactive	Attractiveness and beauty	colour	variety
Codes extracted from exploratory interviews with users	Environmental comfort	1 Quietness & enabling concentration									--							
		2 Window function & dimensions								--							---	
		3 Light, light source, light colour (artificial)					---										---	
		4 Air conditioning & thermal comfort								---							---	
	Leisure time and relaxation	5 Vegetation & landscape in the inside space														---		---
		6 Vegetation & landscape in the outside space														---		---
		7 Visual views in the inside space														---		---
		8 Visual views in the outside space														---		---

Rest of table 4..

			Indicators obtained from the literature review															
				Spatial & geometric features			Human environmental comfort conditions					Equipment		Functional aspects		Aesthetic aspects		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Flexibility	Integrity and coherence	Accessibility	Geometry	Lighting	Comfortability	Safety and Security	Being constant in the environment and environmentally suitable	Quietness and silence	Furniture	Extendibility and suitability for information technology	Being cost-effective	Being organized and interactive	Attractiveness and beauty	colour	variety
Management & planning	9	How long the study hall is open																
	10	Digital services										---						
	11	Access to internet										---						
Spatial organization	12	Flexible space for group activities	---															
	13	Accessibility & layout			---													
	14	Spatial hierarchy													---			---
	15	Environmental graphics																
	16	Enclosure & continuity																
	17	Geometry & height				---												
Quality of furniture and shelving	18	Electrical facilities & the Internet on desks					---	---				---	----	---				
	19	Material of desks, chairs, & shelves	---					---				---				---		---
	20	Compliance with ergonomics in furniture						---										

Conclusion

While explaining the quality of the architectural space of the study hall of academic libraries based on user preferences, the present research makes it possible for designers, architects, environmental planners, and employers to make effective decisions to recreate the desired library space. Based on Fig. 21, it seems that in the design of academic libraries with the aim of the maximum presence of users, the two components of environmental comfort and spatial organization are of great importance for the improvement of the environmental quality of academic libraries. Additionally, the quality of furniture and shelving, leisure time and relaxation, and management and planning are the next priorities. While developing literature related to the architecture of academic libraries in Iran and presenting a conceptual model (Fig. 22) of users' preferences, the present study is a suitable source for decision-makers and managers of academic libraries, planners, architects, and environmental designers. Since the richness of the physical qualities of the environment is always effective in improving the presence of users in the space, future research can use the qualitative, quantitative, and mixed approaches and explain the hidden layers of the subject of the present research considering the above five concepts and expand the literature by proposing and formulating new issues related to the quality of the architecture of the academic libraries.

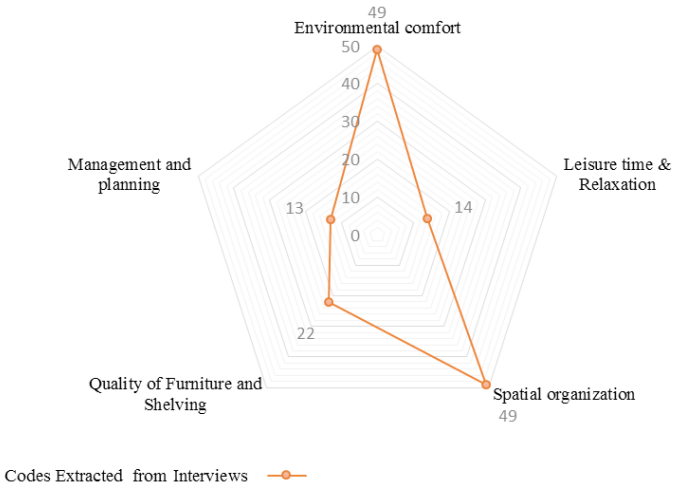

Fig. 21. The importance of each of the codes extracted from interviews conducted with users. Source: Authors.

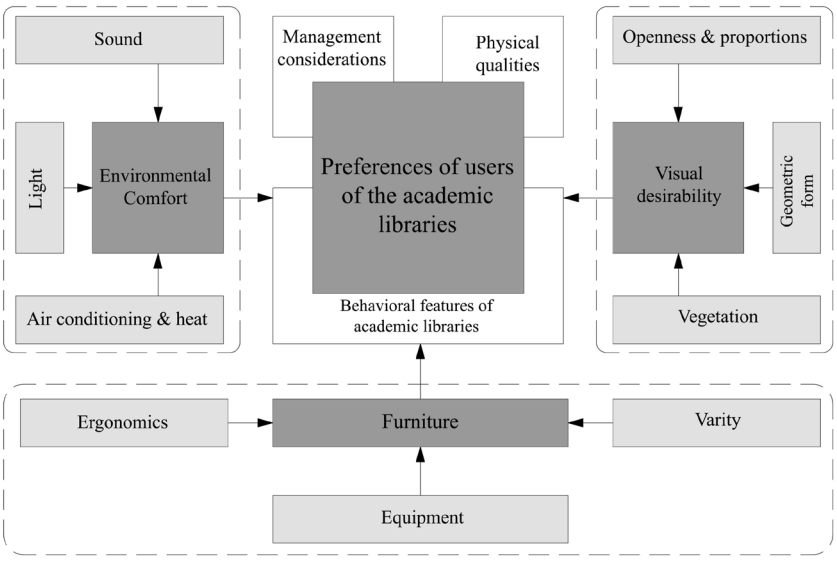

Fig. 22. Conceptual model of preferences and attentions of users in Iranian academic libraries. Source: Authors.

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