RESEARCH ARTICLE

Proposing of a Model for Introducing Environmental Psychology Indexes in the Design of Bookless Academic Library in Iran with a Case Study Approach

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Abstract: Today, it is necessary to use bookless libraries due to the increasing addition of new scientific articles and documents to previous sources and other related problems. This study aimed to propose a model for introducing the environmental psychology indices of the bookless library for Art and Architecture faculties by studying a case study at the Faculties of Art and Architecture of the Islamic Azad University, Tehran South Branch. This research, based on its nature, subject, and objectives, used the quantitative method. The statistical population of the study was the students studying at above-mentioned faculties. Stratified random sampling method was employed to select the participants. The study was carried out in eight steps. In the first step, library resources such as books and reputable scientific articles were used for collecting the basic data. In the second step, reputable articles were used to find scientific design indices. In the third step, some indices were selected from the obtained indices for the design, and a questionnaire was prepared based on them. In the fourth step, the opinion of the supervisor was used for assessing the validity of the questionnaire, and the Cronbach's alpha coefficient was used for measuring the reliability of the questionnaire. In the fifth step, questionnaires were distributed among the students, and their agreement to each index in the design was questioned. In the sixth step, the data obtained from the questionnaires were divided into three groups of variables: Environmental psychology, internal architecture, and digital equipment and furniture, then the data were analyzed by SPSS. The seventh step dealt with the hypotheses. Kolmogorov–Smirnov Est, one-sample *t*-test, independent *t*-test, and one-way variance analysis were used to test the hypotheses. In the final step, the results were obtained to prioritize the indices of internal space design. The results showed that indices with a mean more than 4 were mentioned as core indices, and indices with a score of more than 3.5 were considered as important indices. Finally, it can be concluded that the mentioned indexes will provide a desirable environment for designing a bookless library.

Keywords: Bookless library; Paperless space; Design pattern; Introducing indices; Environment psychology; Art and Architecture faculty

1. Introduction

Today, it is important to present and transmit up-to-date information[1]. The invention of printing in the 1450s brought the production and publication of books of Medieval into a new phase called the Gothenburg Revolution, and to date, we have seen many changes in the technology of book production and maintenance so that bookless libraries are now one of the most significant ones[2]. The emergence of digital culture is an integral part of the glorious intermediate process

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between human and machine and between the physical and electronic world. These intermediaries were increasingly visual, increasingly including speech, touch, and movement. However, we use speech recognition technology and touch screens on a daily basis[3]. With the advancement of technology, the need for a presence in the present and survival in the future has intensified the existence of digitalized contexts, affected activity, thinking and human relationships, and brought new interactive spaces. As a main influential and influenced factor in this process, human being takes the central place of interactive design and requires "user-centered" designs. One of these user-centered spaces is the library that theorists referred to it in the idea of paperless spaces to reduce the paper production and consumption in the world, and the most notable of these non-paper libraries is called "Bookless Library." The physical elements of a bookless library differ from the paper library and also spread a different culture, although they have a similar identity. The recognized most important physical elements of the bookless library are a space for gathering and group study, technological equipment, open plan, and how spaces interact with each other.

1.1. Significance of the study

The increased sale and presentation of e-books compared to the paper books, the increased amount of scientific resources produced annually than previous years, and added new resources to previous ones make it possible that more physical space is occupied in libraries. Furthermore, paper resources are exposed to chemical, physical, and biological damages over time[1]. Acceleration of producing new resources is one of the main challenges facing libraries in providing resources and keeping them up to date. Some problems in traditional libraries are inaccessibility to valuable reference books for everyone, the limited numbers of copies of each resource, and the damage of paper books over time. Therefore, it can be a good option to benefit from the bookless library. Information in these libraries is only available in digital form, and potential model of libraries is for modernizing, increasing flexible and available space, spending less cost, and maintaining natural resources[4]. Another need for using bookless libraries includes physical characteristics, appearance, facilities, and technology used to create an exciting and entertaining space to encourage reading and promoting the culture of reading, rapid access to necessary information, a place for research, rapid sharing of information, presentation of new forms of information, and the ease of updating information and reducing current costs. Thus, this study aims to provide a model to introduce academic bookless library design indices in Iran. Hence, the study seeks to recognize the bookless library and its characteristics obtain the desired indices by students and provide a design pattern on this basis[5].

1.2. Questions of the study

According to the Iranian Art and Architecture students, what are the desirable environmental psychological indexes of a bookless library?

1.3. Review of the literature

In a study titled "the evolution of architecture over library types and principles of library design," libraries have taken different forms from the past till now. This paper investigated the effect of the existence of a physical program on the architectural design of libraries, which increases the number of visitors. Furthermore, the paper examined the superiority of information technology in libraries and comparison of traditional libraries with digital libraries[6]. A research titled "evaluating design indices of digital libraries" studied 14 key indices for designing digital libraries, of which the indices that received the highest score are reliable and sustainable access to resources, resource selection, resource development, infrastructure development, equipment, and observing the intellectual property of all resources. Other indices, including identification of special users, interoperability with other libraries, standardization, and the use of printed resources along with digital resources, have been observed in more than half of the libraries under study. Reference services are one of the most basic services that each library can provide with its users[2]. As a result of research titled "a basis for designing digital library maturity model," building these libraries is always associated with a lot of challenges. These challenges are pursued by maturity models, which are the characteristics of a phenomenon divided into different layers. For this purpose, the characteristics of each level should be first improved or realized, and then, the improvement of the next level follows.

Finally, a maturity model can be designed for a digital library to achieve more efficiency and more effectiveness of digital library using it[7].

2. Interactive Design

Usually, the application of interaction modification is specified as "mutual and reciprocal action or influence." In 1901, the Dictionary of Philosophy and Psychology, based on examples on the relationship between mind and body and interaction of objects and environment, often referred to as interactions, defined interaction as "the relationship between two individuals with one another, which causes advancement, hindering, limiting, and other effects on each other"[8]. Thus, by changing spaces and creating new spaces, technology has changed the design of spaces and introduced new spaces with new design by creating an interactive space of the concept of space and time[10]. Scientists believe that the following results can be achieved by interacting: Improvement in behavior, deeper exchanges through computer systems, creativity and decrease of worry, increase of marketing opportunities, insights on problem-solving skills[11].

2.1. Definition of bookless library

Bookless (digital) libraries are institutions that provide facilities, including specialist staff for selecting, structuring, providing intelligent access, interpreting, distributing, maintaining, and ensuring the permanence of digital information sources over time; as a result, these resources are always ready and economically available for use by a given community or a set of communities. In another definition, the bookless library is a live context that establishes communication between users and information. These libraries are recognized by the services they provide, not their resources[4]. What reveals the differences and characteristics of the bookless libraries are the tendency of individuals to sense the physical environment of the library, which can interact with the user and respond to their behaviors. These libraries are similar to a media center without physical books whose purpose is to collect documents and books digitally. This will direct people to the digital-virtual world of the future, and these types of libraries are a step toward the future of science and technology[3].

3. Methodology

Based on the objectives proposed, this is a quantitative study with a positivist approach for its scientific advancement. The positivist approach addresses description, explanation, prediction and control of variables, harmonics, and phenomena. This method considers the efficiency and effectiveness of the variables with quantitative variables. The statistical population of the study is the students of the Faculty of Arts and Architecture of South Tehran. Stratified random sampling method was used to select the participants. The study was designed in eight steps. For this purpose, in the first step, library resources such as books and reputable scientific articles were used to collect the basic information. In the second step, internet sources such as Arch daily and Library Design blogs were used to find scientific indices for the design of the bookless library. In the third step, using the indices obtained in the second step, the separation of related indices was done based on the level of compliance with the existing site in the building of the Faculty of Arts and Architecture of South Tehran to design according to the size, area, efficiency, and internal facilities available to place the most important required spaces for the bookless library. Consequently, 39 design indices were selected and a questionnaire was prepared based on them to use the students' comments in the interior design of space through the written interview method. Classification of questions is based on a 5-point Likert scale by examining the selected indices. The fourth step deals with the supervisor's comments to measure the content validity of the questionnaire. Cronbach's alpha coefficient was used for measuring the questionnaire reliability. In the fifth step, questionnaires were distributed among MA students in the Faculty of Arts and Architecture of South Tehran. In the sixth step, the data obtained from the questionnaires were divided into three groups of variables: Environmental psychology, internal architecture, and digital equipment and furniture, then the data were analyzed by SPSS. The seventh step examined the hypotheses. Kolmogorov–Smirnov test for normalizing data distribution, one-sample *t*-test, independent *t*-test, and one-way variance analysis were used to test the hypotheses. In the eighth step, the final results were obtained to

prioritize the indices of internal space design, and the design was achieved using them and taking advantage of the existing conditions.

3.1. Reliability of the questionnaire

For the questionnaire to have acceptable reliability, the alpha value should be above 0.7, and the closer it gets to one, the questionnaire has higher reliability. In this research, Cronbach's alpha coefficient was tested for 30 people and each variable, and this value, according to the obtained alpha, is 0.82. Thus, the questionnaire is reliable. Table 1 shows the results of the reliability of the variables.

4. Results

The launch of the "user interface" scheme first occurred when computer designers recognized that users had pragmatic minds, and the most important thing is how to achieve the performance of this mind. This could change the pattern of interaction. This theory is often known as art and science together, and it plays a great role in the future of interactive computing[12]. "User-centric" design is a collection of powerful tools that any design can use to create a better design[9]. In this theory, the most possibly stable space is created based on different human existential dimensions. The components of entertainment, participation, the feeling of space, and habitat are supposed to provide differences and similarities in esthetics; therefore, the design unifying factor affects the user through good and innovative design[10].

4.1. Introducing effective indices in evaluation

In the present study, we extracted the design principles of a bookless library and its functional indices. According to the indices obtained and the literature review on the subject, a mental model was arranged to show how to classify the design objects while mentioning the source, which is shown in Tables 2 and 3.

Table 1. The reliability of the research variables

Variable	Reliability (α)
The role of environmental psychology in the formation of a bookless library	0.71

Table 2. Indices obtained from literature review – important

Important	Reference	Important	Reference
Special users	(Alidousti and Sheikhshoaei, 2006)[2] (Aghaie, 2014)[1]	Distance with other users	(Altman, 1992)[13] (Hasheminejad, Haidari, and Mohammad Hoseini, 2013)[4] (Hall, 1990)[14]
Using partition in separating spaces	(Benteley *et al*., 2003)[15] (Juhani, 2012)[16]	Ability to reserve tables	(Lancaster, 2017)[17]
Usability for the public	(Wood, 2007)[18] (Lang, 1987)[19] (Dadgaran, 2000)[20] (Brewster Hjorth, 2012)[21]	Placing[21] sub-set of other spaces	(Haghparast Azad, 2015)[22]
Separating study space by Men and women	(Norberg-Schulz, 1986)[23] (Pratt and Nunes, 2012)[24]	Physical opportunities	(Haghparast Azad, 2015)[22]
Separate entrance and exit on the main street	(National Building Regulations, 2013)	Amphitheater show curtain	(Bruke, 2013)[25]
Not seeing the screen in individual study tables		(Ross Macfarlan, 2016)[26] (Benteley *et al*., 2003)[15] (Pakzad and Bozorgh, 2012)[27]	

5. Data Description

Of the distributed questionnaires, 96 were complete and assessable. Table 4 shows that 14.6% of the students study in the general field, including educational disciplines, general psychology, and clinical psychology, 46.9% study in architectural disciplines, internal architecture, bionic architecture, digital architecture, architectural technology, and architectural restoration, and 38.5% of the study in art disciplines such as art research and clothing design.

5.1. Determining the distribution of variables values

To select a variable test, we first need to know whether to use parametric or nonparametric tests. One of the main criteria for this option is the Kolmogorov–Smirnov test. For this purpose, it is necessary to evaluate the variables distribution in terms of normal distribution of variables. After the SPSS analysis in the Kolmogorov–Smirnov test, the significance level

Table 3. Indices obtained from literature review – core

Core	Reference	Core	Reference
Full-text sources	(Aghaie, 2014)[1] (Ghanbari, 2015)[26]	Socio-petal focal space	(Kawstek, 2008)[29] (Kingsbury, 2017)[30] (Haghparast Azad, 2015)[22]
Reliable and stable access	(Ghanbari, 2015)[28] (Alidousti and Sheikhshoaei, 2006)[2]	Spending free time	(Kubota and Bachman, 2012)[31] (Rouzbeh, 2009)[32] (Yousefpour, 2006)[33]
Type of resource format	(Aghaie, 2014)[1]	E-book reader tablet	(Lancaster, 2017)[15] (Pratt and Nunes, 2012)[22]
How to search and market resources	(Aghaie, 2014)[1]	Library user-account	(Khodadadeh and Yaghobian, 2007)[34] (Mostaghna, 2005)[35] (Aghaei, 2014)[1] (Panahi and Azari, 2014)[10] (Thanuskodi, 2015)[36] (Liverouw and Livingstone, 2010)[11]
Collecting information	(Aghaie, 2014)[1]	Integration of library space with university	(Benteley, Alcock *et al*., 2003)[15] (Lancaster, 2017)[17]
Infrastructure development	(Alidousti and Sheikhshoaei, 2006)[2] (Aghaie, 2014)[1]	Ability to expand resources	(Alidousti and Sheikhshoaei, 2006)[2]
Observing the intellectual property of resources	(Alidousti and Sheikhshoaei, 2006)[2] (Aghaie, 2014)	The existence of a physical program in the architectural design	(Ghanbari, 2015)[28]
Specialized human power	(Aghaie, 2014)[1]	Design like a thought room	(Jhy and Hamlin, 2009)[37]
Interoperability with other libraries	(Alidousti and Sheikhshoaei, 2006)[2] (Aghaie, 2014)[1] (Leiverouw and Livingstone, 2010)[11] (Thanuskodi, 2015)[36]	Multi-functionality	(Lelieveld, 2013)[38] (Lancaster, 2017)[17] (Sanders, 2011)[39] (Hasheminejad, Haidari and Mohammad Hosseini, 2013)[4] (Haghparast Azad, 2015)[22]
Ability to select resources	(Alidousti and Sheikhshoaei, 2006)[2]	Resource selection	(Alidousti and Sheikhshoaei, 2006)[2]

Table 4. Frequency distribution of student's study field

No.	Variable	Study field	Number of students (%)
1	Students' study field	General	14 (14.6)
2		Architecture	45 (46.9)
3		Art	37 (38.5)
Total			96 (100)

of the test was obtained to be higher than 0.05 that shows the distribution is normal in all variables. Therefore, parametric tests should be used to assess the variables. Table 5 indicates the results of the Kolmogorov–Smirnov test to determine the normal distribution of variables.

6. Data Analysis

6.1. Hypothesis testing

a. The main hypothesis of the study: Interactive design plays a role in the design of the bookless library.

According to Table 6 and based on the information of the one-sample *t*-test, it is observed that the calculated mean of the index for interactive design features in the design of bookless library is 3.57 at the level of α=0.05 and t=14.48 with a degree of freedom of 95. It can be said that it is greater than the assumed mean of the population (i.e., 3) and the critical t value with a certainty of 95%. Hence, it is found that the main feature of the internal architecture of a bookless library is the characteristics related to its interactive design that include the sum of the variables.

b. The first hypothesis: Environmental psychology affects the formation of space and optimal use of the bookless library.

According to Table 7 and one-sample *t*-test, it is observed that the mean of the index calculated for the environmental psychology indices in creating bookless library, 3.72, is greater than the assumed mean value of the average level (3) and the t critical value at the level of α=0.05, and t=16.17 with a degree of freedom of 95 and with a certainty of 95%.

With regard to Table 7, it can be explained that the level of agreement with: (1) Establishing the library as a place for gathering student, innovation, and group study; (2) the tendency to use the library to spend free time between classes; (3) the tendency that the library communicates with other internal and external digital libraries; (4) the need to design space as a thought room with access to computers; (5) table layout to place the students of same specialty together; (6) the importance of not seeing the screen of the computer during the study; (7) using book reader tablets for reading e-books; (8) the tendency to having an account in the digital library of the faculty; (9) the tendency to reserve library tables for themselves and friends beforehand; (10) paying money and purchasing books during study; (11) the ability to use digital library of the faculty for the public on Thursdays and Fridays; and (12) having a specified distance with friends and colleagues is greater than the assumed mean (3).

However, in terms of the item of the level of agreement with the separation of the study hall for male and female, this amount is less than the assumed average of the society (3), indicating that this item does not affect the creation of a bookless library.

6.2. Discussion and interpretation of hypotheses testing

In explaining the first test related to environmental psychology, we can conclude that the indices with a score of more than 4 were considered as first-order or core indices, whose internal architecture was as follows: (1) Designing the main library space collectively and collaboratively, and (2) individual study tables should be considered in such a way that students do not be surrounded by the screens of each other during studying, and indices with a score of more

Table 5. Identifying the normality of the distribution of variable values

Components	Number of acceptable questionnaires	Mean±standard deviation	Test result	Test significance level
Application role of space	96	3.72±0.43	0.7	0.7

Table 6. Test results for the variable of the effect of interactive design in the design of the bookless library

Variables (indices)	Number	Degree of freedom	Mean±standard deviation	Sig.	t statistics
The role of interactive design in the design of the bookless library	96	95	3.57±0.38	0.000	14.68

Table 7. Test results for the variable of the effect of environmental psychology on creating a bookless library

Variables	Number	Degree of freedom	Mean±standard deviation	Significance	t statistics
The level of agreement with the library as a place for gathering student, innovation and group study	96	95	4.06±1.21	0.000	8.58
The level of tendency to use the library to spend free time between classes	96	95	3.91±1.13	0.000	7.94
The level of tendency that the library communicates with other internal and external digital libraries	96	95	4.53±0.96	0.000	15.59
The need to design space as a thought room with access to computers	96	95	3.97±1.13	0.000	8.46
The level of agreement with placing desks of the students of the same specialty together	96	95	3.62±1.23	0.000	4.96
The importance of not seeing the screen of the computer during the study	96	95	4.02±1.08	0.000	9.21
The level of preferring reader tablets for reading e-books	96	95	3.75±1.2	0.000	6.09
The level of agreement with separating the study hall of women and men	96	95	2.21±1.47	0.51	5.19
The tendency to having an account in the digital library of the faculty	96	95	4.33±1.01	0.000	12.9
The tendency to reserve library tables for themselves and friends beforehand	96	95	3.65±1.21	0.000	5.3
The level of agreement to pay money and purchase books during study	96	95	3.34±1.51	0.028	2.22
The level of agreement with the ability to use digital library of the faculty for the public on Thursdays and Fridays	96	95	3.73±1.28	0.000	5.64
The level of preferring to have a specified distance with friends and colleagues	96	95	3.18±1.12	0.04	1.63
The role of environmental psychology in the formation of bookless library	96	95	3.72±0.43	0.000	16.17

than 3.5 were considered as second-order or important indices, whose internal architectural design was as follows: (1) Changing the interior design of the library space from the habitual typical state and creating a happy and fun space for exchanging information and cooperation (2) embedding study furniture with compatible and comfortable ergonomics for reading with e-book tablets, (3) multi-touch three-dimensional modeling for designers at the space center with reservation capabilities, and (4) designing group study tables to be used by students of the same specialty for performing group projects.

7. Conclusion

Architectural space is the space of users and is a terrain architecture to increase awareness and promotion, in which, educational and cultural institutions, including the library, play the greatest role. In this design, the physical elements of the bookless library are different and promote a different culture. Based on the results of the hypotheses and given the detailed description of the students' perspective in terms of the proposed indices and also literature review, it can be concluded that the design and construction of the proposed indices in the introduced model (Figure 1) provide interior design indices for an academic bookless library in Iran, which ultimately provides the appropriate space to the students in a bookless library.

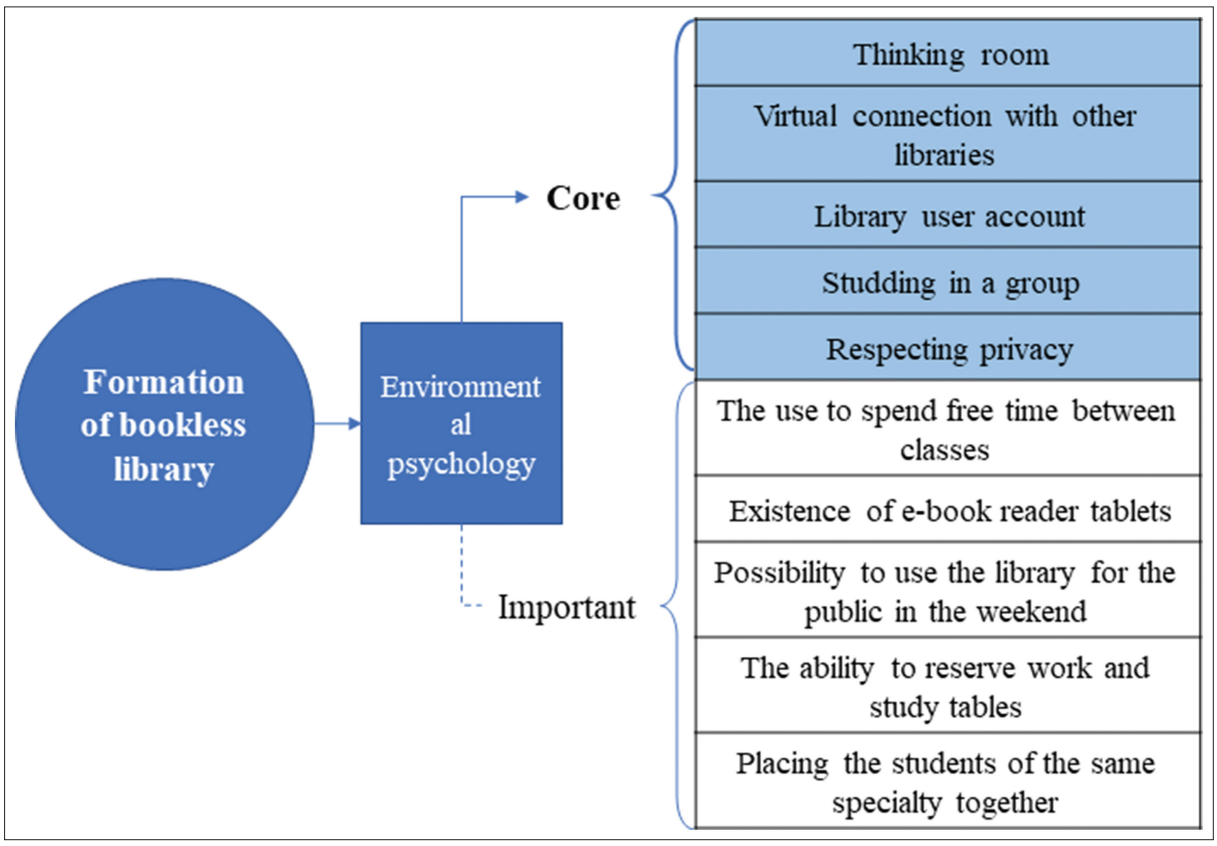

Figure 1. External and internal sources of support.

8. Providing Academic Strategies

- Developing and expanding the capabilities of digital libraries through sharing experiences
- Contributing to the newly established digital library projects
- Removing the geographic fence to enhance knowledge
- Strengthening the relationship between communication and collaboration between academic, research, industrial, and governmental population.

9. Limitations of the Study

One of the problematic factors was the lack of a full understanding of the students' knowledge of a bookless library. Thus, the digital equipment needed by the students was considered in the questions raised.

Moreover, due to the lack of a bookless library in Iran, only a similar case study and foreign cases were reviewed for a better understanding of the subject.

10. Recommendations

It is suggested that future research compares the history of interactive design in the formation of a bookless library and depicts a comprehensive model using a factor analysis method for building a national bookless library in Iran by reviewing articles and internal and external designs, including academic research or constructed buildings through a statistical population that includes the general public and university professors.

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