

Analysis of the Users' Perception of Daylighting in Newly Libraries of Algeria

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Abstract

Libraries are symbols of knowledge, as they are the main resource of information. They also have significant social role, and a great effect on human mood and social behaviour. The design of libraries can enhance or hinder motivation for the student to use them not only during exams, but also in free time. The importance of daylight in buildings is nowadays of particular interest, in terms of visual comfort and well-being in particular in educational environment, such as libraries where appropriate daylight levels must be provided, to allow the users to carry out their work quickly and precisely, and to create a comfortable environment, suitable to prevent physical problems, scarcity of motivation and sleepiness. Several studies have also suggested that daylight may have a positive impact on student performance. In the current study, users' perception is examined using a questionnaire to investigate problems of natural lighting to contribute to enhance visual comfort, and satisfaction of library occupants with the qualities of their visual environment. The case study is a library representative of newly building facades in Algeria. Results analysis indicates that most of the participants felt very pleasant with lighting conditions overall in the library. However, the daylighting system still needs to be improved.

Key words: Architecture, Daylighting, User Satisfaction, Visual Comfort, Well Being.

1. INTRODUCTION

Light provides us with the information and sensation of the world around us. It can be perceived as the richest experience our sense has to offer (Pniewska, 2012). It provides constantly the direct stimuli, needed to mark the rhythm of life and contribute to feel well and healthy (Boyce, 2003). The use of daylight in buildings where people live most of their time is of great importance for their health, comfort and well-being. It has also an influence on the circadian rhythms: Studies have shown that daily rhythms such as sleep, mood and body temperature are negatively impacted due to lack of daylight exposure (Wijesundara & Gamage, 2021). In fact, daylight interacts with our natural biological system essential for the functioning of the metabolic and immune systems (Hauge, 2015). According to A. Wijesundara & W. Gamage (2021), lack of exposure to daylighting for prolonged periods of time will result in vitamin D deficiency followed by weakened body defenses and an aggravation of chronic diseases (Wijesundara & Gamage, 2021). In addition, studies have revealed positive effects of daylight on comfortable feeling and improving human perception mood (Kellert et al, 2008) and on regulating physiological and psychological functions as emotions, etc (Altomonte, 2008).

In a workplace, daylight can positively influence the health of office personnel, improve efficiency, reduce unnecessary sick leave and result in greater benefits for enhanced productivity (Altomonte, 2008).

Considering the significant impact of lighting on visual activities, the impact of daylight on human performance in educational spaces becomes most important. In fact, activities in dark classrooms or libraries will cause physical problems for users. Recent studies has shown that lack of daylight in educational classrooms results in higher blood melatonin (sleep hormone) levels of students in these classrooms than those in classrooms with good lighting. This factor causes sleepiness among students and undermines their performance (Takahashi et al, 2001) (Belia et al, 2013). In this context, Heschong (2002) showed that children performed better and learned faster in the classrooms with good daylighting (Ahadi et al, 2016). Also, Karemera (2003) has found that student performance is significantly correlated with satisfaction with academic environment.

The importance of daylight in buildings is nowadays of particular interest, in particular in educational environment, where appropriate daylight levels must be provided. So, it is very important to consider lighting while designing architectural spaces in terms of visual comfort and well-being. particularly, in educational spaces such as libraries to

allow the users to carry out their work quickly and accurately (Pniewska, 2012), and to create a comfortable environment to prevent disease, lack of motivation and sometimes even sickness (De Carli et al, 2008). For this purpose it is crucial to pay attention to natural light, due to high level of visual activities (which are done during the day in most cases). The design of libraries can enhance or hinder motivation for the student to use them not only during exams, but also in free time (Ridzwan Othman & Mohd Mazli, 2012). And has a great effect on human mood and social behaviour.

In the present study, the quality of daylight and student satisfaction with daylighting quality was investigated in a library. Architectural factors of providing adequate daylight for libraries were evaluated. The most important parameter is the visual comfort. It is investigated by a questionnaire survey. The main objective is to find out the user satisfaction with the quality of lighting offered by the library, the presence of glare and, their needs with regards to daylight, to identify strengths and weaknesses of lighting. Most important goals are:

- (1) Daylight performance evaluation,
- (2) Examination of the relationship between users' satisfaction and architectural parameters with regards to the visual environment.

The results could be useful for physical reformation of the studied example and also for new educational built environments which are conducive to human health.

2. METHODOLOGY

All participants of the present field study are university students. Their ages are between 20 and 25 years old. The purpose of our questionnaire is to measure the satisfaction of users of the university library with regard to visual comfort. Satisfaction was measured through a set of questions related to the selected key criteria:

- 1- How much daylight illuminance is sufficient for students in the reading room of the library?
- 2- What factors have caused favorable or unfavorable daylight quality in the reading room?
- 3- Which architectural solution could reform unfavorable factors of daylight?

2.1. Study Context and Geographic Location

To achieve the objective, research was done in the library of the central university of Mila, Algeria. Case study is selected based on the most recurrent and representative typology of newly building facades in Algeria. Mila (36°27'1.01" N 6°15'51.98" E.) has Mediterranean climate, classified as Csa based on Köppen-Geiger. Based on the meteorological database Meteonorm (2021), the average annual sunshine hours in Mila is 3000 hrs per year. Figure 1 shows the reading room of the case study library.



Figure 1. Views of the reading room of the library of the central university of Mila.

3. QUESTIONNAIRE SURVEY

A questionnaire was completed by a total sample of library users of $n=30$. It was addressed to the students during the day hours. Questionnaire was divided into three parts. In first part, students were asked general demographic questions, relating to their gender and age as background information in order to differentiate them on the basis of their socio-biological status.

The second part comprises objective questions about their physical environment, such orientation, preference seating, and their activities in the library. Part 3 concerned the students' satisfaction with the building visual environment and discussed issues such as glare control.

Regarding occupants' activity, both groups (computer/ paperwork) were considered in assessing the visual performance of the studied library.

3.1. Results and Discussion

The data analysis was established from the questionnaires replies from the library users, and the observation of the users of the reading room behavior.

3.1.1. Age and Gender

As participant age was between 20 and 26 years, 100% of the subjects are younger than 40 years of age, so no significant age-related eye diseases that affect seniors predictable. According to gender, females were 66.6 % of the total library users (fig. 2).

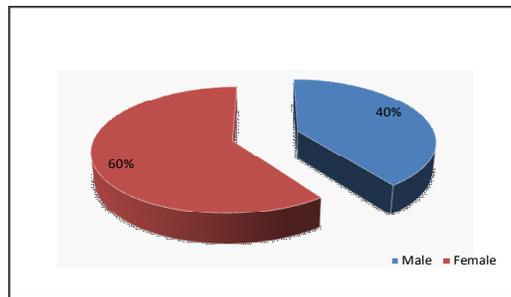


Figure 2. Distribution of responders by gender

3.1.2. Different Student Activities in the Library

Questionnaire contained 5 available activities in a library. According to the results, the below fig.3 shows the details of what students really do once they are inside the library. It shows that (30%) of them come to read books or journals, (24%) come to write and 2% are present for drawing. In total we note that the use of paper (books or journal) is the first tool because most students (a total of 56 %) come to the library for using academic documents. The use of the screen comes next (25,33%). 18,67 % visit library for other reasons.

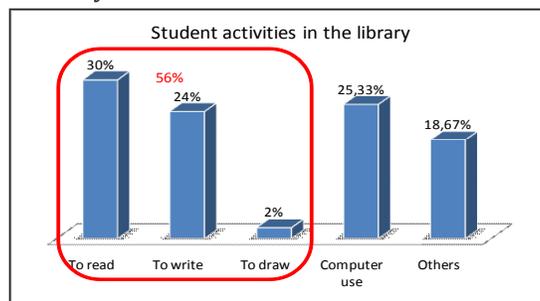


Figure 3. Distribution of responders by groups according to their activities.

3.1.3. Frequency of Computer Use

Previous studies have shown that users of the library tended to make greater use of computer. In our case study, the collected data shows that the frequency of the computer use in the reading room of the library which varies between 2 and 4 hours (44,82%) is the most important, followed by that less than 2 hours (37,93%), and then beyond than 4 hours (17,24 %) (fig.4).

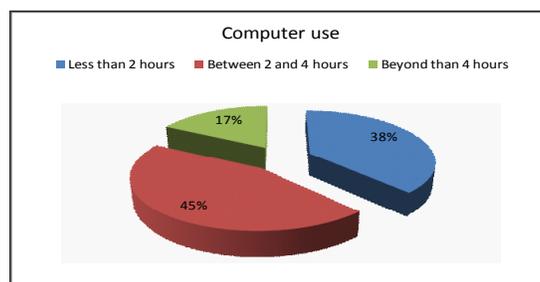


Figure 4. Frequency of computer use

3.1.4. The Main User Requirements for a Reading Room in a Library

The main user requirements are investigated to find out the relationships between the occupant satisfaction and some design strategies related to satisfaction achievement. Seven factors were put forward. The result indicates that students prefer quiet spaces. In fact, calm was considered to be most important for 26% of the responders. The lighting had the highest percentage 22 % to complete individual work after the calm (fig.5). Indeed, a library with a lack of sufficient natural or artificial lighting, is unlikely to fulfil the 'good reading' criteria. A room that's overly lighted or underlighted is not only uncomfortable to study in, but can have a significant impact on concentration levels. In the current study, the outside view is ranked fourth by the users with a rate of 9%.

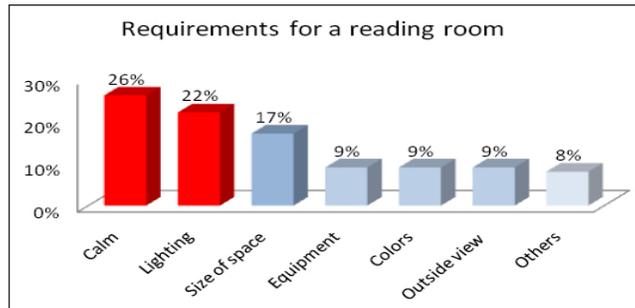


Figure 5. The main user requirements for a reading room

3.1.5. Relationship between Seat Preferences and Visual Environment

From the data analysis, it was found that daylight affects strongly the seating preference of the users by a percentage of 70% (53, 33 % of respondents which prefer to seat near the window + 16, 66% which avoid sitting near the window) (Fig. 6). A percentage of 30% of responders prefer a particular place in the library and the location chosen by the students follows the tools they use, specific resources; the presence of calm, distance from other users...

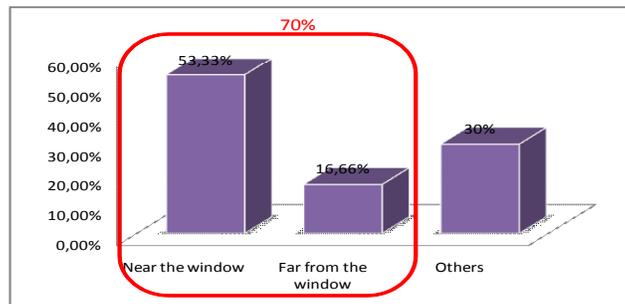


Figure 6. Relationship between seat preferences and visual environment

3.1.6. Visual Comfort Perception

Visual comfort perception is based on several parameters such as illuminance, glare, and light distribution. Questionnaire contained 5-point scale for visual comfort perception. In which 5 showed "strongly comfortable" and 1 as "uncomfortable". It was found that visual comfort perception is very variable from one individual to another. In fact, students perceived it variously: from uncomfortable to very pleasant. Only 13, 33% of users are not satisfied by the lighting environment in the reading room. Inversely, over than the half (56, 66%) found it comfortable (fig.7).

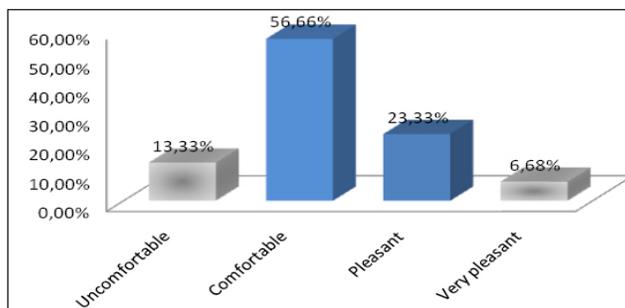


Figure 7. Result of a general evaluation of the visual comfort perception by responders

3.1.7. Light Level Perceived by Users

The light level is investigated by a question which will give more details than the precedent question. It is obvious that users' evaluation will associate the light level with the correct functioning of their activities. Questionnaire contained 5-point scale for daylighting level in the reading room, in which 5 showed "excessive lighting" and 1 as "very low lighting". The results indicate that the preferred illuminance level is perceived variously by students (fig.8). The percentage of students which reported very low lighting level on the work plane was just 3,33%. The same percentage (3,33%) represent students which found the workplane too bright (excessive lighting), and therefore they are affected by direct sunlight. the subjects which reported a suitable light level in this space were 50 % and those who found it very suitable were 23,33 %. As a result 73, 33% of the responders were satisfied with the lighting level.

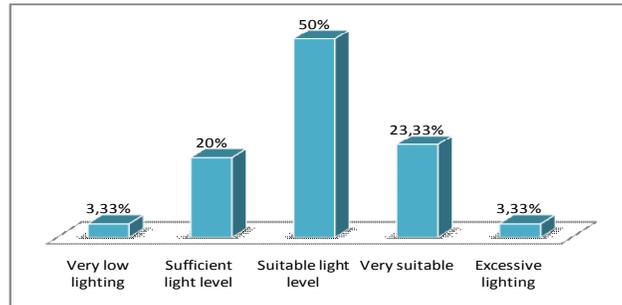


Figure 8. The light level perceived by the library users

3.1.8. Presence of Glare

Problems with glare was assumed problematic for screen and paper users, although it varie widely from one person to another. In fact, 60% of people were very unsatisfied with presence of discomfort glare from daylighting, and 40% seems to ignore it (fig.9). This can be explained by the fact that various tasks have different light requirements. Also, the presence of glare depends on the time of the day, and the users seat.

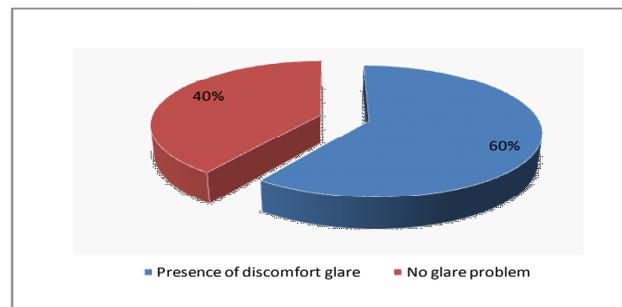


Figure 9. Presence of glare

3.1.9. Solution of Glare Problem in the Reading Room

According to result analysis, it was found that users will avoid direct sunlight by choosing their seat (73, 33%), while the 26, 66% adjust the position of their computer to avoid glare (fig.10). In fact, adjusting the computer position depending on sun spot presence can make the screen more visible, and its use more visually comfortable.

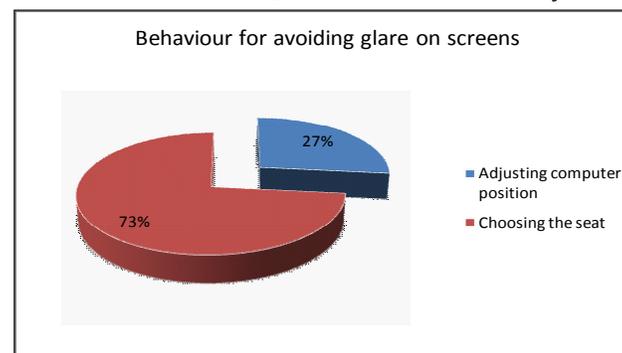


Figure 10. Solution of glare problem.

3.1.10. Improvement Measures of Natural Lighting Design in Reading Spaces

Behavior factors have a significant impact on luminous comfort. The importance of providing the building and its users with the control of daylighting was suggested to lead to occupants' comfort. Adjustable shading devices on the windows of the library can help readers adjust the natural lighting according to the outdoor natural light illumination and indoor reading demand. Research results show that adjustable shading is a very important element of users visual comfort (66,6%) , where Zero ratings (0%) pertain to users finding the presence of shading unnecessary. 33,3% found that tinted glazing can eliminate glare and improve visual conditions (fig.11).

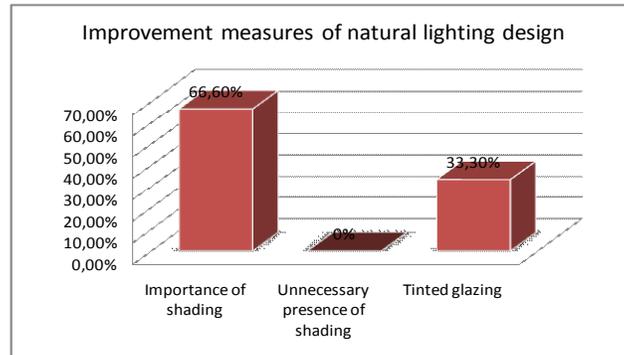


Figure 11. Improvement measures of natural lighting design in reading spaces

3.1.11. Investigation of Light Type Required by the Reading Room Users

To improve luminous conditions in the reading room, daylighting, artificial lighting and hybride lighting we suggested. The research indicates a high percentage (66,6%) of agreement with the statement that "The natural lighting in a library gives comfortable conditions (fig.12). Many studies have demonstrated that if daylight is the primary source of lighting, there is a great improvement in productivity, performance and well-being in general. (De Carli, 2008). The use of hybrid lighting is the second relevant choice for obtaining a visual comfort, and improving lighting conditions (26, 6%). The lighting condition that would satisfy other people (6, 66%) is the use of artificial lighting which is the less widely favored by the responders.

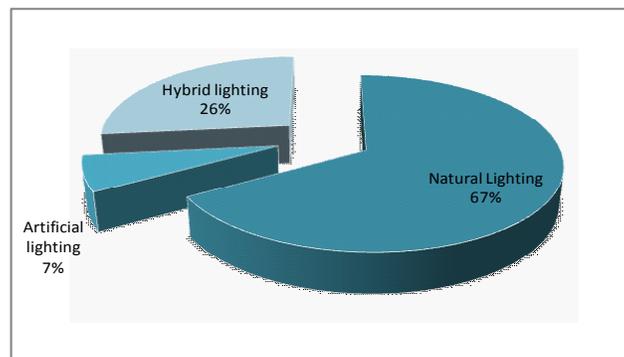


Figure 12. Light type required by the reading room users.

4. CONCLUSION

It is very important to consider lighting especially natural light while designing libraries to contribute to the health and wellbeing of the occupants. A questionnaire survey was conducted to investigate the users' satisfaction of daylighting in a library representative of newly building facades in Algeria. It investigated the satisfaction of library occupants with the qualities of their visual environment, illustrated the problems of natural lighting of reading spaces and searched for the improvement measures for the design of natural lighting. Results draw the following main conclusions:

- Lighting is the most important factor to complete individual work ranked after calm.
- Visual comfort perception is very variable from one individual to another.
- Natural lighting is more required than artificial lighting to provide comfortable conditions. So, integration of natural light with the design is an important factor with respect to libraries.

- In summary from the questionnaire most of the participants felt very pleasant with lighting conditions overall in the library, but according to result analysis the daylighting system still needs to be improved. The main problem is the presence of glare.
- Improvement can be achieved by using adjustable shading devices to avoid glare, secondly by using tinted glazing on the windows.

The results could be useful for rehabilitation of the studied example and also for new sustainable built environments which are conducive to human health and well being.

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