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Indoor Environmental Quality Assessment of University Facilities Through Post-Occupancy Evaluation

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ABSTRACT

This paper aims to assess user satisfaction in terms of performance and indoor environmental quality (IEQ), by comparing two university buildings in Algeria namely; the building of the Faculty of Architecture of the University of Oum el Bouaghi and that of the University of Constantine, in order to emphasize the importance of participation in their living environment, and to see the effectiveness of pre-established guides for design and construction. A Post-Occupancy Evaluation approach was used with a user satisfaction survey to identify problems affecting the two building IEQ. The study showed that the elements of building performance are strongly uncorrelated with user satisfaction. However, there is an improvement in the IEQ and occupant satisfaction at the University of Constantine compared to that of Oum el Bouaghi.

Keywords: Post-Occupancy Evaluation (POE), Indoor Environment Quality (IEQ), User satisfaction, Educational Environment.

INTRODUCTION

All infrastructure has its own agreed design standards that guide construction. When planning to build a building, the architectural designers and the contractors should build with regards to these standards. These are generally codified in a manual, which aims to construct functional and appropriate buildings. However, there are many cases where a building does not perform as expected, despite the design guidelines. This malfunction is linked, among other things, to poor performance (Tookaloo and Smith 2015). How it is possible to construct a building, based on codes and environmental design requirements, and yet it does not work as well as expected?

According to Manezes et al (Menezes et al. 2012), there is a documented gap between the planned and actual performance of a building. Architectural design is the result of a sophisticated multi-level process involving various aspects (e.g. philosophical, functional, environmental, aesthetic, contextual, and socio-cultural) (Ahmadi, Saiki, and Ellis 2016). However, the main question is whether or not it has succeeded in meeting users expectations: maintaining good quality of interior and exterior spaces; as well as the achievement of the building objective, without restricting the interior environment or disturbing work productivity, especially with regard to educational buildings.

Educational facilities and their surroundings require the utmost care to be constructed for efficient operation and productivity (Olatunji 2013). Several studies indicated that inadequate facilities have led to an unproductive educational environment (Higgins et al. 2005; Haynes 2008; Scott-Webber, Strickland, and Kapitula 2013; Imms, Cleveland, and Fisher 2016; Fabozzi and Dama 2020).

User's academic success is influenced by a myriad of variables ranging from socioeconomic background to internal motivation; a variable that is often underestimated is the role of the built environment (Blincoe 2008; Durán-Narucki 2008; Earthman 2004; Kumar, O'Malley, and Johnston 2008; Schneider 2002). The factors of the built environment affect retention, attention, motivation, learning and academic success (Scott-Webber, Strickland, and Kapitula 2013). Khalil et al (Khalil, Husin, and Budin 2009) showed in their analysis that if a higher education building experiences poor environmental conditions, it will demotivate students in terms of learning process, thereby reducing the quality of student outcomes.

The Indoor Environment Quality (IEQ) is an environmental problem that concerns lighting levels, thermal comfort, air

quality and acoustics inside a space (Rohde et al. 2020; Kamaruzzaman et al. 2018). Leaman (Leaman 1995) concluded in his study that: people who are not satisfied with the temperature, air quality, lighting and noise conditions in their workspaces are more likely to say that this affects their productivity at work.

Several studies shared the same observation; Indoor Air Quality (IAQ) (Fabozzi and Dama 2020; Wargocki et al. 1999; Kosonen and Tan 2004; Michael et al. 2005; Jacobsen et al. 2008; Webster et al. 2008; Y. S. Lee 2011; Al Horr et al. 2016; Kang, Ou, and Mak 2017). Thermal Comfort (Fabozzi and Dama 2020; Seppänen, Fisk, and Lei 2006; Frontczak and Wargocki 2011; Stylianos 2014; Ibrahim et al. 2021). Noise levels - acoustic comfort. (Jacobsen et al. 2008; Stylianos 2014; Smith-Jackson and Klein 2009; Kim and de Dear 2012; C. Mak 2012; C. M. Mak 2015; P. J. Lee et al. 2015; Aboulfotouh, Tolba, and Ezzeldin 2020). Lighting conditions (Seppänen, Fisk, and Lei 2006; Stylianos 2014; Hathaway et al. 1992; Fisk and Rosenfeld 1997; Heschong 1999; 2003; Humphreys 2013; Asmar, Chokor, and Srour 2014; Sithravel and Ibrahim 2021).

Based on this theoretical research, this study is conducted by focusing on these four key aspects of IEQ in educational facilities and in particular on their effects on occupant satisfaction. In short, our review of the literature showed that there was a growing interest in the post-occupancy evaluation for educational places in developed countries; however, these studies are limited in Algeria. Although various types of educational buildings have been studied separately, insufficient attention has been granted to the evaluation of a university campus after its occupancy. Architects often fail to learn simple lessons from completed projects and end up repeating mistakes that could easily be avoided (Bordass and Leaman 2005).

Thus and in the context of post-occupancy evaluation, our research compares two educational buildings; one was intended for architectural studies, in other words according to the manuals and guides of educational building standards (Faculty Of Architecture of Constantine, Case study n°:2). The other was built for another purpose and was subsequently reassigned for teaching architecture (Faculty Of Architecture of Oum el Bouaghi, Case study n°: 1). In both cases, the user was not taken into account during the design process. This study deals with the IEQ performance of university buildings from the occupant point of view, in order to underline the importance of participation in their living environment, and to see the effectiveness of pre-established guides for construction.

PRESENTATION OF THE CASE STUDY

Case Study N°1: The Faculty of Architecture of Oum El Bouaghi

This faculty was built in 1983 to decongest the main universities (for example: Constantine, Batna...). Architecture teaching was launched in 2010, and took place at the department of Urban Technical Management (UTM), after a year, it was transferred to an old construction. This building was not designed for architecture teaching. This situation has led to a malfunction of the educational infrastructure. The department is made up of two areas (block A and block B). Block A consists of administrative offices, as well as classrooms, while Block B is reserved for workshops. Both are mounted on one floor (see Figure 1-a).

Case study n°2: The Faculty Of Architecture of Constantine

It is located in the University Pole 3 in the New City of Constantine; the faculty was inaugurated seven years ago; with 27,564 m^2 general area and 7,244.75 m^2 of built area. The department consists of three floors. The compact design is made up of several geometric shapes: circle, square and triangle, viewed from above the general shape of the faculty is a rounded triangle at the tip (see Figure 1-b).

MATERIALS AND METHODS

The POE was defined by Zimring and Reizenstein (1980) as an examination of environmental design effeciveness in relation to users occupation (Zimring and Reizenstein 1980). Zimmerman and Martin (cited by Turpin-Brooks and Viccars 2006) stated that the POE generally focuses on the evaluation of user satisfaction and its functional adequacy with a specific space. Generally, the judgment criteria are users' satisfaction and their needs.

POE "is the process of evaluating buildings in a systematic and rigorous manner after they have been constructed and occupied for a certain time" (Preiser, White, and Rabinowitz 2015). POE is one of the best ways to find obstacles and

mistakes. It differs from other assessment methods because it emphasizes the needs and satisfaction of the occupant (Preiser and Vischer 2005). One of the goals of POE in higher education is to determine whether the building meets the goals and visions of the university.

The stage of examination that we chose for our study is the strategic examination which makes it possible to evaluate to what extent the buildings are likely to meet future needs and if they were able to meet changing needs until present. This examination uses the "investigation" level (Blyth and Gilby 2006).

Through the POE guidelines, a survey was conducted in the two architecture departments. Two sets of data were collected: qualitative and quantitative. Qualitative data were obtained from open-ended questions. The quantitative data for their part were obtained from closed questions.

The questionnaire was formulated from the following guides: Methodological guide for sustainable construction (La Direction des bâtiments et de la logistique (DBL) 2012), Thermal comfort inside an establishment (Charbonneau and Douville 2004), Guide to Post Occupancy Evaluation (Blyth and Gilby 2006). There were two questionnaires; the first was established in 2016 in The Faculty Of Architecture of Oum el Bouaghi (case study n° 1). The second questionnaire was established in 2020 in The Faculty Of Architecture of Constantine (case study n° 2), with two formats depending on the location; one targeting students and lecturers (workshop / classroom) and the other targeting administrative staff (administration). The questionnaire had four sections. The first concerned general information on the respondents: age, gender, their sensitivity to cold / heat and their choice of clothing. The second focused on thermal comfort inside the building. The third section concerned the air quality inside the workshop / classroom / administrative offices, the perception of the room brightness, humidity, sunshine, as well as thermal satisfaction. Finally, the fourth section was about the framework. It included a question on satisfaction with the work environment quality, in addition to open-ended questions on the elements that influence this quality, as well as suggestions for improvements. The responses were evaluated by using data editing and analysing program of Statistical Package for the Social Sciences (SPSS).

The study population was students, teachers and administrative staff occupying the architecture departments: 66.67% were women and 33.33% of men for the case study n° 1. The majority of respondents (82.5%) were between 20-30 years old. The study was carried out between December and January 2015-2016 (for a master degree research). We distributed 60 questionnaires and received 45 complete responses. For the case study n° 2, 67.3% were women and 32.7% were men. The majority of respondents (67.3%) were between 20-30 years old. The study was carried out in February 2020. We distributed 70 and we received 55 complete responses. That gives us a total of 100 complete responses.

RESULTS AND DISCUSSIONS

Case Study N° 1: The Faculty of Architecture of Oum El Bouaghi

Criteria 1: Thermal Comfort in The Building

The results obtained revealed that 29.55% of users have a "normal sensitivity" to cold, and 26.55% are "slightly sensitive" and "extremely sensitive". As for the "normal sensitivity" to heat, we have 47.73%, and 25% and 11.36% are "rather sensitive" and "extremely sensitive" respectively.

Reading Table 1, it appears that the results obtained are in the order of 81.40% of users were dissatisfied with the overall quality of the thermal comfort (natural and artificial) of the building.

Table1. General satisfaction with the thermal environment.

		Effectives	Percentage	Valid percentage	Cumulated Percentage
Valid	No	35	77,8	81,4	81,4
	Yes	8	17,8	18,6	100,0
	Total	43	95,6	100,0	
Missing	Missing system	2	4,4		
	Total	2	4,4		
Total		45	100,0		

Figure1. (a) The Faculty of Architecture of Oum el Bouaghi (Case n°1). (b) The Faculty of Architecture of Constantine (Case n° 2).

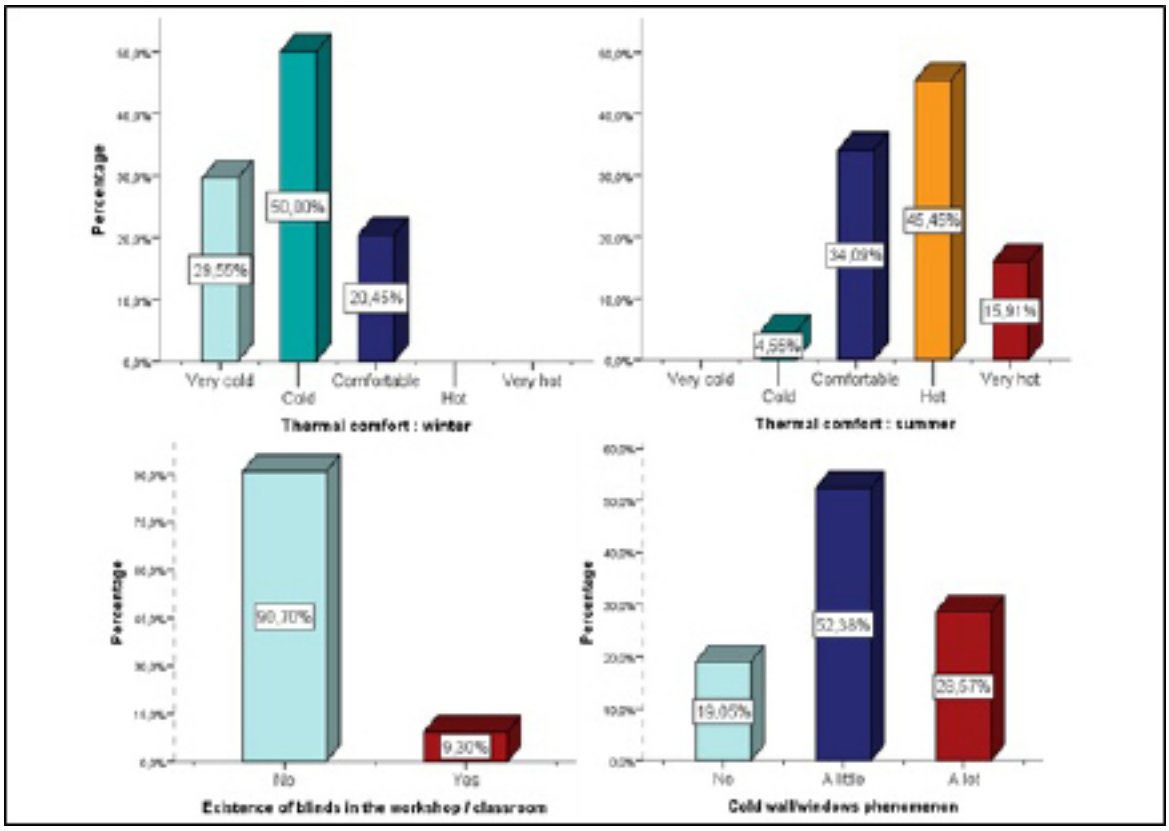

Figure2. The perception of thermal comfort. (a) Thermal comfort (winter/ summer). (b) Existence of blinds in the workshops/ classrooms. (c) Cold walls/ windows phenomen.

In winter, more than half of users (79.55%) found the building “cold” or “very cold” and only a small portion (20.45%) found the interior temperature “comfortable”. In contrast, in summer, half of them (45.45%) rated the building "hot" and about a third (34.09%) found it "comfortable" (see Figure 2- a).

For shading devices (blinds), 81.4% and 90.7%, results indicated the absence of interior and exterior blinds respectively (see Figure 2- b).

The results concerning the insulation of walls and windows are mainly based on occupant’s sensations in relation to cold walls and windows, which allows them to conclude the effectiveness of the insulators. Thus, through Figure 2- c, half of the results (52.83%) indicated that they are "a little" exposed to the phenomenon of cold walls or windows. Moreover, 28.57% find that they are "a lot" exposed to the phenomenon of cold walls or windows.

Criteria 2: Indoor Air Quality

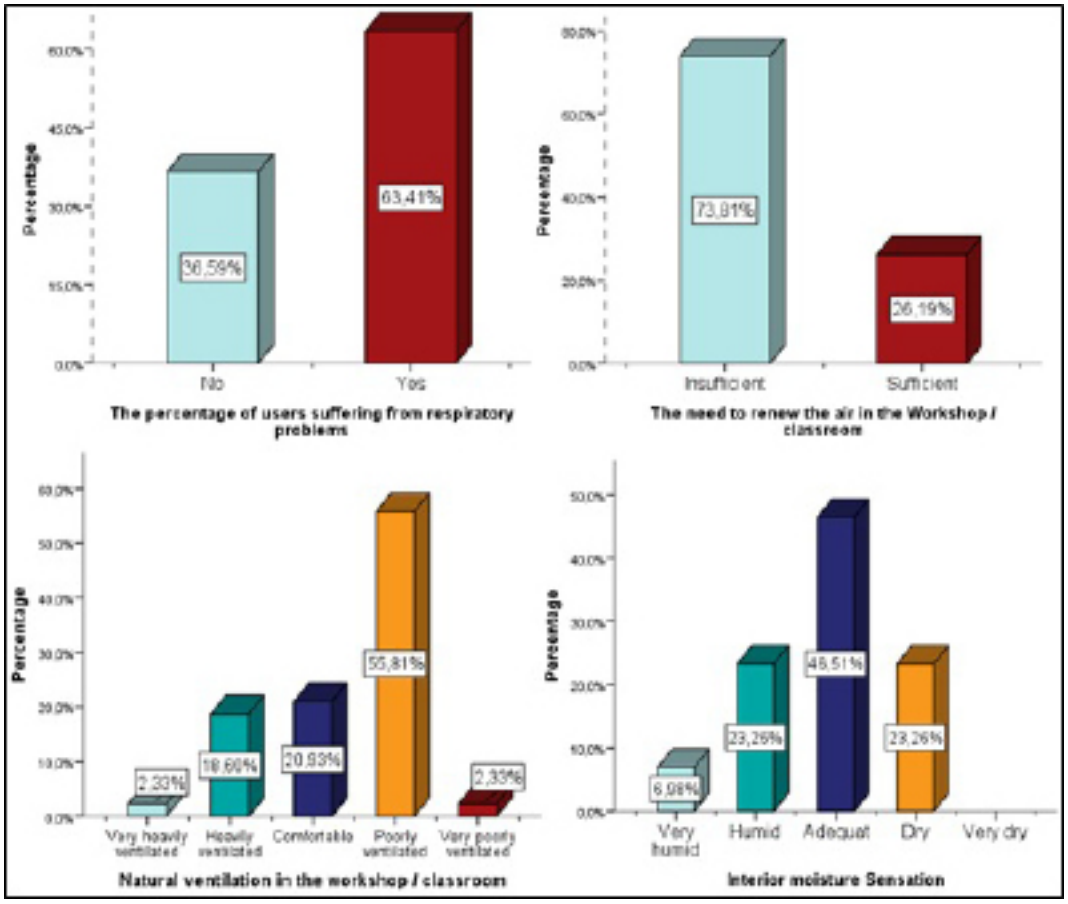

Figure3. The perception of Indoor air quality. (a) The percentage of users suffering from respiratory problems. (b) The need to renew air in the workshop/ classroom. (c) Natural ventilation in the workshop/ classroom. (d) Interior sensation.

The indoor air quality was measured via several parameters; for our case, the parameters set are air renewal, air currents, respiratory discomfort, humidity and the need for ventilation. As for the frequency of air renewal, 73.81% of users found it "insufficient" (see figure 3- b). The vast majority of users (84.09%) reported experiencing drafts and 63.41% encountered breathing problems (see Figure 3- a). Half of the users (55.81%) felt that the building was "poorly ventilated" (see Figure 3- c). As for humidity, the results indicated that 46.5% of users found the indoor environment "adequate", while 23.26% found it "dry" and "humid" (see Figure 3- d).

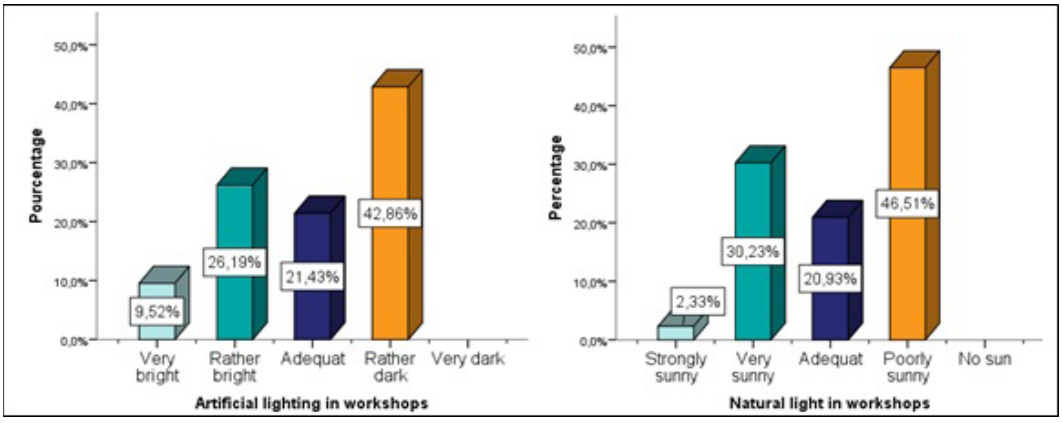

Figure4. The perception of visual comfort. (a) Artificial lighting in the various workshops. (b) Sunlight in the various workshops.

Criteria 3: Visual Comfort

The two parameters of this indicator (natural and artificial lighting) evaluated by the surveyed population indicated respectively 42.8% and 46.5%, these results show that users found that the space was "rather dark" and "poorly sunny". About half of the users (42.06%) were moderately dissatisfied with the overall quality and the adequacy of the interior lighting (natural and artificial; see Figure 4).

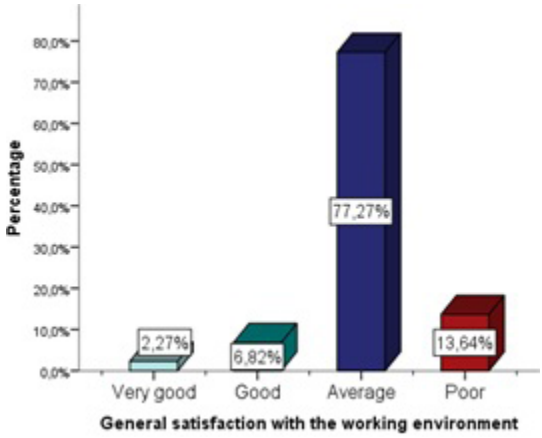

Figure5. General satisfaction with the working environment.

Criteria 4: The Working Environment

For the evaluation of the working environment, a scale was adopted (very good, good, average or poor). The results presented in Figure 5, highlight that most users were moderately (77.27%) satisfied with their work environment.

Results of Open Questions With Users

This part concerns the qualitative study of case study n° 1. Open questions were asked in order to get opinion about working environment quality, problems encountered and the improvements suggested. Among the problems encountered, the most common are thermal, acoustic, visual comfort, bad smells from the sanitary facilities, and the poor orientation of the building, the ergonomics of the workspace as well as the furniture and colors. Some examples of responses "problem of cold walls, materials and construction quality, lack of lighting, etc. ». Most of the suggestions to improve it were focused on the choice of colors, interior and exterior redevelopment, thermal insulation, central heating, as well as sun protection.

Case Study N° 2: The Faculty of Architecture of Constantine

Criteria 1: Thermal Comfort in The Building

The results obtained revealed that 37.73% of users have a "normal sensitivity" to cold, and more than half (52.83%) are "rather sensitive" and "extremely sensitive". As for the “normal sensitivity” to heat, we have 44.44%. 35.19% and 16.67% are “rather sensitive” and “extremely sensitive” respectively.

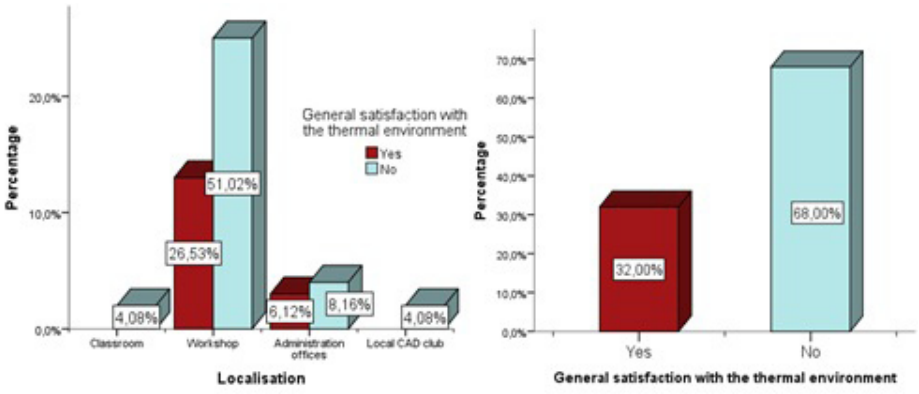

Figure6. General satisfaction with the thermal environment and depending on the location.

Reading Figure 6, it appears that the results obtained are in the order of 51.02% from users were dissatisfied with the overall quality of thermal comfort in the workshop, while 26.53% were satisfied. 4.08% dissatisfied in the classroom. 8.16% in administrative offices with 6.12% satisfaction. Overall, we have more than half (68%) dissatisfied versus 32% satisfied.

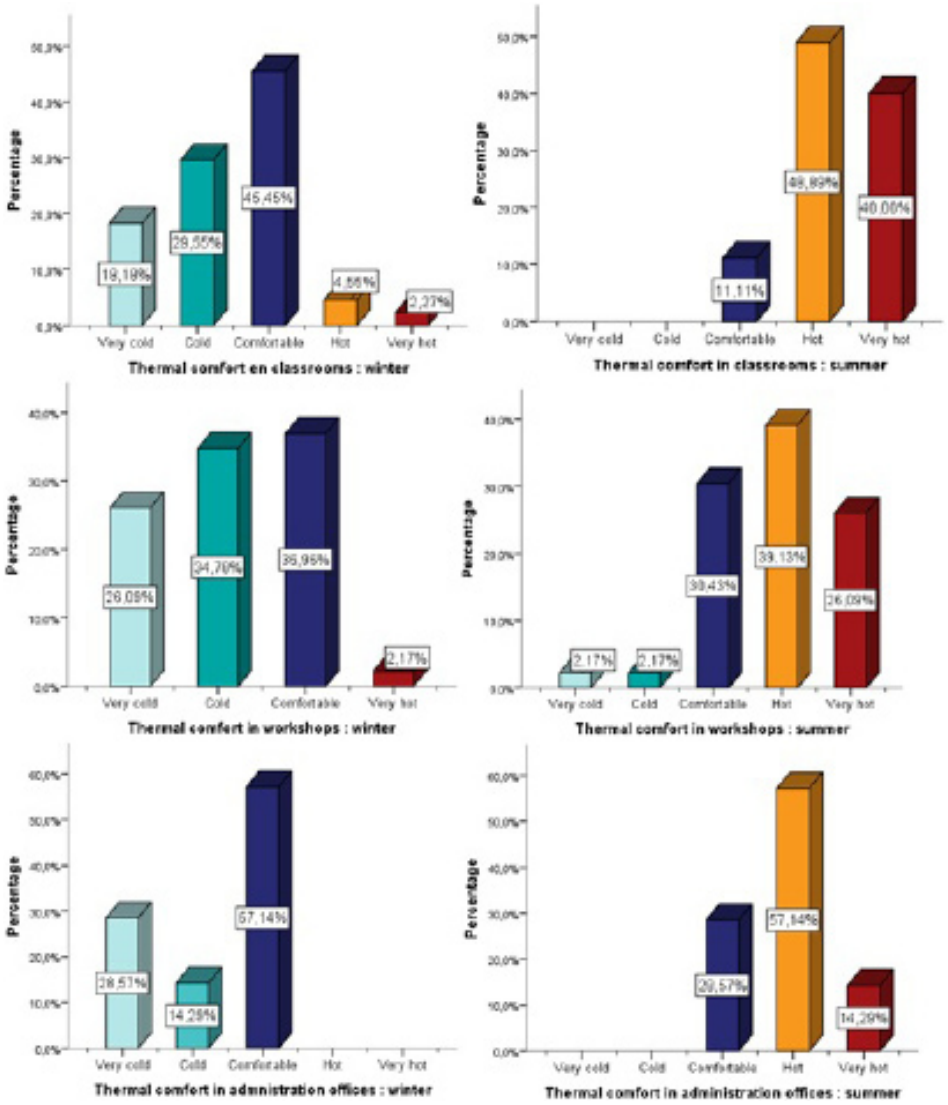

Figure7. The perception of thermal comfort (part 1) - (a) Classrooms (winter/ summer). (b) Workshops (winter/ summer). (c) Administrative offices (winter/ summer).

In winter, inside the classroom about half of the users (45.45%) found the building "comfortable", the other half qualified the thermal environment as "cold" or "very cold" and only a small portion (4.55%, 2.27%) found the interior temperature "hot" and "very hot". On the contrary, in summer, the majority of them (88.89%) described the building as "hot, 48.89%" or "very hot, 40%" and only a small portion (11.11%) found it "comfortable" (see Figure 7- a).

As for the workshops, in winter, more than half of the users (60.87%) found the building “cold, 34.78%” or “very cold, 26.09%”, around a third described the thermal environment as “comfortable” and only a small portion (2.17%) found the interior temperature "hot". On the contrary, in summer, more than half of them (65.22%) qualified the building as “hot, 39.13%” or “very hot, 26.09%”, around a third qualified it as “comfortable” and only a small portion (4.34%) found "cold" and "very cold" (see Figure 7- b).

For administrative offices, in winter, more than half of users (57.14%) found the building "comfortable"; the other half described the thermal environment as "cold" or "very cold" 14.29%, 28.57% respectively. On the contrary, in summer, the majority of them (71.43%) qualified the building as "hot, 57.14%" or "very hot, 14.29%" and 28.57% qualified it as "comfortable" (see Figure 7- c).

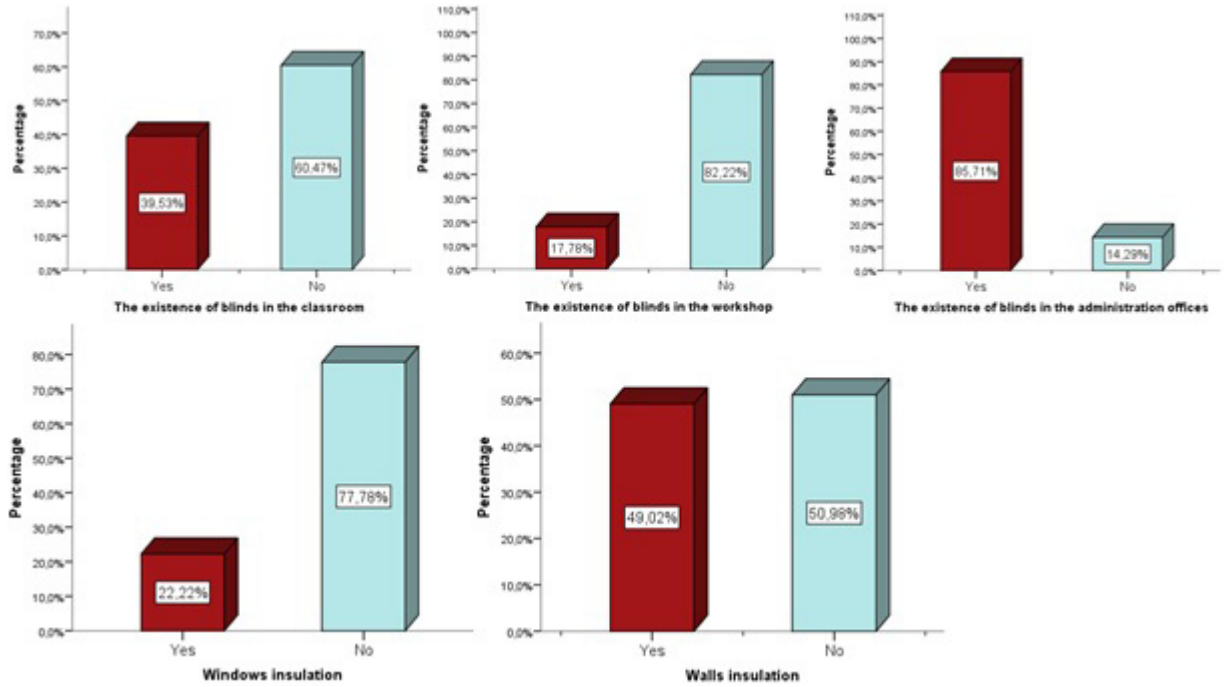

Figure8. The perception of thermal comfort (part 2) - (a) The existence of blinds in the classroom / workshop / administrative offices. (b) Cold wall/windows phenomenon.

For shading devices (blinds), more than half (60.47%) of the results indicate the absence of external blinds in classrooms, 82.22% indicated their inexistence in workshops. As for the administrative offices, 85.71% of the results indicated their existence (see Figure 8- a).

The results concerning walls insulation and windows are mainly based on occupant's sensations in relation to cold walls and windows, which allows them to conclude the effectiveness of the insulators. Thus, through Figure 8- b, half of the results (50.89%) indicate that there is no insulation of the walls or insufficient insulation, that is to say a feeling of cold walls. Also for window insulation, the majority of results (77.78%) indicate that there is no window insulation or insufficient insulation, hence a feeling of cold windows.

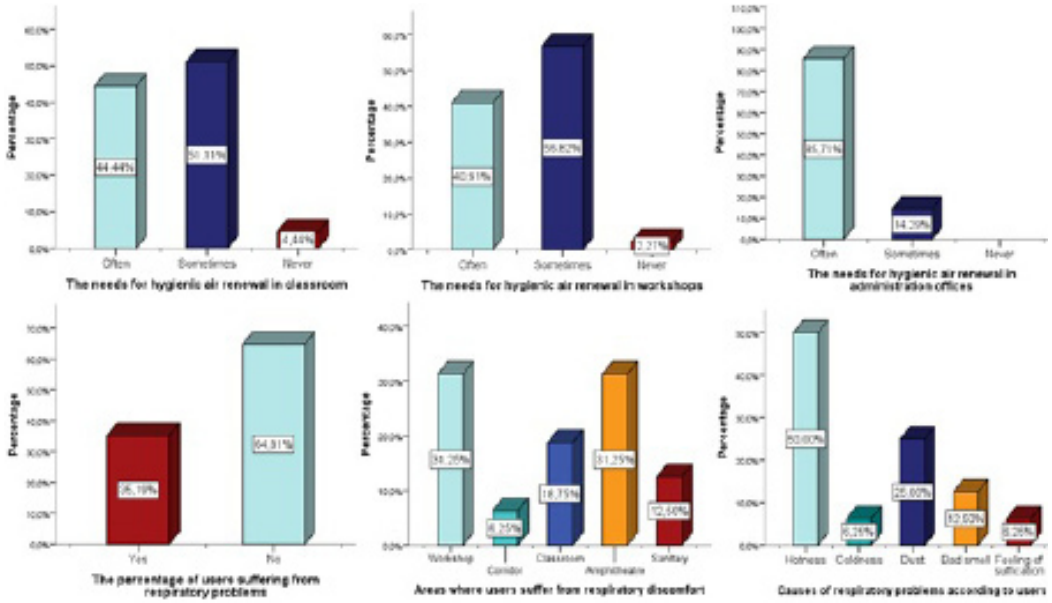

Figure9. The perception of Indoor air quality (part 1) - (a) The needs for hygienic air renewal in the various workspaces. (b) Users suffering from respiratory problems. (c) Areas where users suffered from respiratory discomfort. (d) Causes of respiratory problems according to users.

Criteria 2: Indoor Air Quality

The indoor air quality was measured via several parameters; for our case, the parameters set are air renewal, air currents, respiratory discomfort, humidity and the need for ventilation. For the need for hygienic air renewal in the classroom (44.44%, 51.11%) replied "often" and "sometimes" respectively, for the workshops (40.91%, 56.82%) replied " often "and" sometimes "respectively, as for the administrative offices (85.71%, 14.29%) replied" often "and" sometimes "respectively (see Figure 9- a).

Half of the users (51.91%) reported having experienced drafts and 64.81% encountered breathing problems (see Figure 9- b), mainly in the workshops and amphitheaters (31.25%) and classroom (18.75%) (see Figure 9- c). According to Figure 9- d, Heat (50%), dust (25%), bad odors (12.50%) and a feeling of suffocation (12.25%) caused these respiratory discomforts.

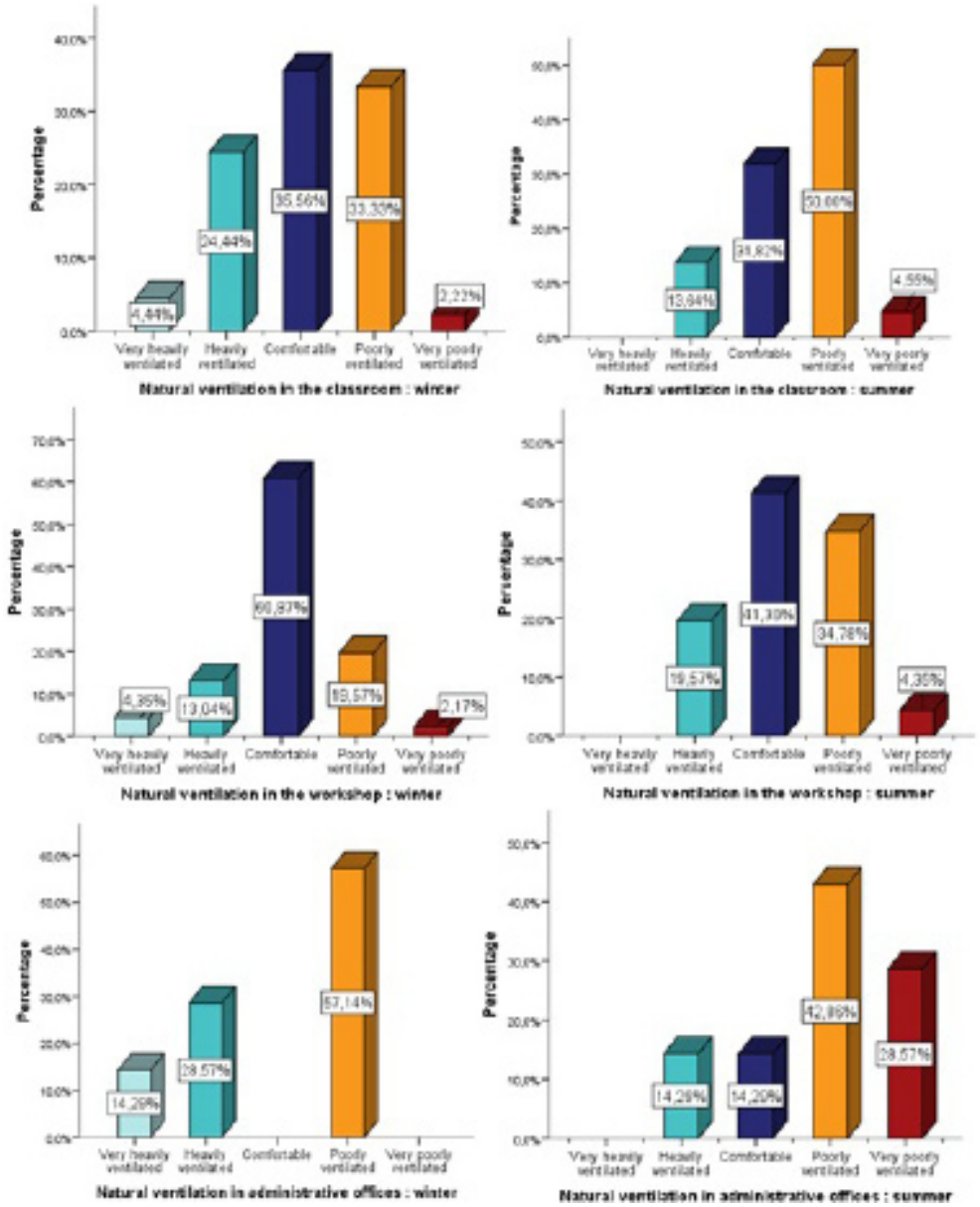

Figure10. The perception of Indoor air quality (part 2) – (a) Natural ventilation in the classrooms (summer / winter). (b) Natural ventilation in the workshops (summer / winter). (c) Natural ventilation in the administrative offices (summer / winter).

Regarding the ventilation of spaces, starting with classrooms (see figure 10- a). In summer, half of the users (50%) felt that the building was "poorly ventilated" and 31.82% found it "comfortable" and about a third (13.64%) found it "heavily ventilated". In winter, around a third of users (35.56%) found the building "comfortable", the other third (33.33%)

found it "poorly ventilated" and "very poorly ventilated, 2.22%", and 24.44% found it "heavily ventilated". And a small portion (4.44%) found it" very heavily ventilated ".

For workshops, (see figure 10- b). In summer, half of the users (40.3%) felt that the building was "comfortable" and 34.78% found it "poorly ventilated" and around a third (19.57%) found it "heavily ventilated". In winter, more than half of users (60.78%) found the building "comfortable", around a third (19.57%) found it "poorly ventilated" and "very poorly ventilated 2.17%", and 13.04% found it "heavily ventilated" "And a small portion (4.35%) found it" very heavily ventilated ".

Next, we have the administrative offices in Figure 10- c. In summer, around half of the users (42.86%) felt that the spaces were "poorly ventilated", approximately a third (28.57%) found them "very poorly ventilated" and a small portion (14.29%) found them to be "comfortable" and "heavily ventilated". In winter, half of the users (57.14%) found the spaces "poorly ventilated", about a third (28.57%) found them "heavily ventilated" and a small portion (14.29%) found them "very heavily ventilated".

As for humidity, the results indicated that the majority (70.45%) of users found the indoor environment "adequate" in the classroom, more than half (64.44%) found it "adequate" in the workshop, and all (100%) of users found it "adequate" at the administrative office level.

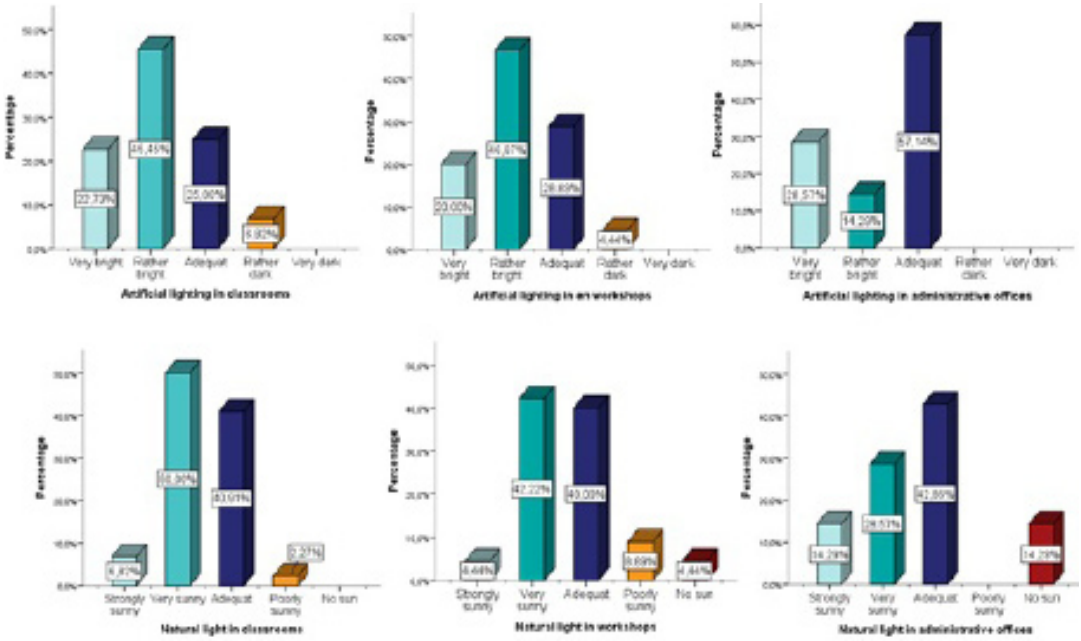

Figure11. The perception of visual comfort. (a) Artificial lighting in the various workspaces (classrooms/ workshops/ administrative offices). (b) Sunlight in the various workspaces (classrooms/ workshops/ administrative offices).

Criteria 3: Visual Comfort

The two parameters of this indicator (natural and artificial lighting) evaluated by the surveyed population indicated that in the classroom 45.45% of users found artificial lighting "rather bright", 22.73% found it "very bright" and only 25% found it "adequate" and a small portion found it "rather dark". As for the workshops, 28.89% of users found the artificial lighting "adequate", the half (46.67%) found it "rather bright" and 20% found it "very bright", while a small portion (4.44%) found it "rather dark". For the administrative offices, the results indicated that more than half (57.41%) of users thought that artificial lighting was "adequate", about a third (28.57%) rated it as "very bright" and a small portion (14.29%) found it "rather bright" (see Figure 11- a).

With regard to natural lighting, first in the classroom, half (50%) of users found the space "very sunny", almost half (40.91%) found it "adequate" and a small portion (2.27%, 6.28%) found it "poorly sunny" and "strongly sunny" respectively. As for the workshops, 40% of users considered the natural lighting to be "adequate", 42.22% found them "very sunny" and a small portion (4.44%) thought that the space lacked sunlight or that it was "very sunny". Compared to administrative offices, the results indicated that 42.86% of users felt that daylighting was "adequate", a third (28.57%)

found that the space was “very sunny” and a small portion (14.29%) considered that there is no sun and that the space was "strongly sunny" (see Figure 11- b).

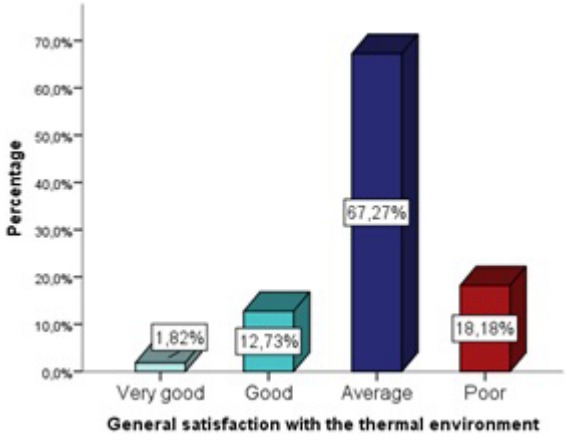

Figure12. General satisfaction with the working environment.

Criteria 4: The Working Environment

The results presented in Figure 12, highlight that most users were moderately (67.27%) satisfied with their work environment. A small portion (12.73%, 18.18%) found the quality of the work environment “good” or “poor” and a very small portion (1.82%) considered that the quality of the work environment was “very good”.

Results of Open Questions With Users

This part concerns the qualitative analysis of case study n° 2. The same open questions were asked. Among the problems encountered, the most widespread are: Thermal comfort, for example: "lack of air conditioning and air renewal, the radiators are always off". Acoustic comfort, for example: “the corridors are inadequate and constitute sound sources; noises caused by students”. Visual comfort, for example: "workshops and classrooms are very sunny", "intensive natural lighting which sometimes leads to glare". Ventilation, for example: "the workshops are very closed and without ventilation". The workspace ergonomics, for example: "the space is too stereotypical" as well as the furniture "no furniture suitable for the work of architecture". Poor architectural quality, for example: "the architecture of the building has a poor quality" as well as the exterior landscape.

Most of the suggestions for improvement were focused on thermal comfort, especially in summer, shading devices, thermal and sound insulation, interior and exterior redevelopment.

Comparison Between The Results of The Two Study Cases

The thermal performance offered in the two case studies is generally not satisfactory. The results obtained through this study confirm this observation with 81.40% of dissatisfaction with the thermal environment for case study n°1 and 68% for case study n°2 (see Summary Table 2).

Table2. Comparison between general satisfactions with the thermal environment.

	Case study n°1		Case study n°2	
	Effectives	Percentage	Effectives	Percentage
Yes	8	18.60	16	32,0
No	35	81.40	34	68,0
Total	43/45	100,0	50/55	100.0

However, the FAO of Constantine is less dissatisfied compared to that of Oum el Bouaghi. According to the open questions, the problems encountered with regard to thermal comfort revolve around air conditioning in summer, although half of the occupants have a normal sensitivity to heat, which allow to note the existence of a malfunction compared to air conditioning system. The overheating in summer in the two study cases is due to the solar gains generated by the large windows and the inexistence of the blinds (for case study n° 1; 90.70%. For case study n° 2: workshop: 82.22% /

administration: 85.71% and 60.47% for classrooms), due to the strong daylight in the spaces (see Summary Table 3). In winter, the problem of cold walls (52.38%) in the FAO of Oum el Bouaghi caused by poor thermal insulation and the tightness of the building envelope is important to take into account. Especially given that this can cause discomfort and a reduction in user performance (Tookaloo and Smith 2015), a problem that is not persistent in the FOA of Constantine.

Table3. Comparison between the existences of shading devices.

	Case study n°1		Case study n°2	
	Effectives	Percentage	Effectives	Percentage
Yes	4	9,30	8	17,78
No	39	90,70	37	82,22
Total	43/45	100,0	45/55	100.0

As for indoor air quality, it is poor in the FOA of Oum el Bouaghi due to poor ventilation (55.81%) as well as the presence of respiratory genes (63.41%) caused by undesirable toilet odors hence the constant need to ventilate the space. For the FOA of Constantine, we noticed a small improvement compared to air renewal. However, the problem of respiratory discomfort is worst compared to that of Oum el Bouaghi (see Summary Table 4). It is mainly at the level of workshops and administration, caused in large part still by heat. As for ventilation, in winter is adequate however in summer a small percentage of satisfied and a majority who find it weak and insufficient. Ventilation is considered an important The visual performance offered in the case studies presented is also not satisfactory. The results obtained confirm this observation. The percentage of occupants who find artificial lighting "comfortable" in their workspaces (Workshop, classroom) is low (around 20%) for the two case studies except for the administrative offices, this percentage increases to more than half for the FOA of Constantine. Others find it dark (see Summary Table 5). For the natural lighting and sunshine, a large majority of dissatisfied in the FOA of Oum el Bouaghi. However, we notice an increase in satisfaction in the FOA of Constantine, almost half (plus 40%) in the different spaces evaluated (workshop, classroom, administration) find it adequate, the other half find it strongly sunny (see Summary Table 5), this is explained by the orientation of these spaces (North-West) and the absence of the shading devices as mentioned above. This too is the cause of the overheating experienced in summer. For the acoustic performance in the two study cases is rather adequate, the existing noise problem is caused by the noise of the students in the corridors.

Table4. Comparison between exposures to respiratory problems.

	Case study n°1		Case study n°2	
	Effectives	Percentage	Effectives	Percentage
Yes	26	63,41	15	35,19
No	15	36,59	28	64,81
Total	41/45	100,0	43/55	100.0

Table5. Comparison between visual comforts (Natural and artificial).

	Case study n°1		Case study n°2	
	Effectives	Percentage	Effectives	Percentage
Very bright	4	9,52	9	20,00
Rather bright	11	26,19	21	46,67
Adequate	9	21,43	13	28,89
Rather dark	18	42,86	2	4,44
Very dark	0	0,00	0	0,00
Total	42/45	100,0	45/55	100,0
Strongly sunny	1	2,33	2	4,44
Very sunny	13	30,23	19	42,22
Adequate	9	20,93	18	40,00
Poorly sunny	20	46,51	4	8,89
No sun	0	0,00	2	4,44
Total	43/45	100,0	45/55	100,0

CONCLUSIONS

As part of the post-occupancy evaluation, a comparison was made between two university buildings. The FOA of Architecture of Constantine built for architecture studies and the FAO of Oum el Bouaghi where the building was reallocated from its main purpose.

This humble work aims to evaluate the performance and the quality of the interior environment of the two university establishments from the point of view of the occupant, in order to underline the importance of the participation of the users in their living environment, and to see the effectiveness of pre-established guides.

The study carried out highlights the difficulties encountered by all users in terms of thermal, visual, olfactory comfort, etc. Despite the good intentions of the building's architectural design, it did not meet the expectations of users on all occasions, because the results highlighted positive aspects as well as certain problems, which affected the performance of the building. 81.40% dissatisfied with the thermal environment in general as well as 77.27% moderately dissatisfied with the quality of the working environment for the FOA of Oum el Bouaghi and 67.27% moderately dissatisfied with the quality of the working environment for the FOA of Constantine (see Summary Table 6). However, the study shows an improvement in the quality and satisfaction of the occupants at the FOA of Constantine compared to that of Oum el Bouaghi. Despite the problems linked to thermal aspects and shading devices.

Table6. Comparison between the general satisfactions with the work environment.

	Case study n°1		Case study n°2	
	Effectives	Percentage	Effectives	Percentage
Very good	1	2,27	1	1,82
Good	3	6,82	7	12,73
Average	34	77,27	37	67,27
Poor	6	13,64	10	18,18
Total	44/45	100,0	55/55	100,0

The impact of the built environment on education is an important parameter (Olatunji 2013). It is therefore essential to produce buildings with a performance that reflects the user's expectations.

In this case study, research shows why there is a need for POE at the university level. By providing examples, it shows how POE improves the quality of design standards in academic institutions in order to have a better and healthier environment and more efficient buildings, as they all affect learning and work performance. POE could be beneficial for the development of inclusive design policy and should be a necessary component of design process (Güvenbaş and Polay 2020).

In addition to these results, this study highlights the urgency of undergoing a post-occupancy evaluation as a method of assessing the performance of university buildings in the Algerian context. The feedback provided by the POE could help to shed good light on the design and operating process and produce more efficient buildings.

This post-occupancy study must result in an architectural and organizational proposal for the building. It is possible to list the factors that must be addressed in a renovation proposal (if there is one):

1. Lighting, ventilation, thermal and acoustic design depending on the orientation climate and the function of the spaces.
2. Improvement of air conditioning systems and shading devices.
3. Furniture and decoration must be suitable for architectural studies and be comfortable and modern.
4. Passive solutions and use of technologies such as photovoltaic panels to reduce the energy consumption of the building.
5. Landscaping.

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Competing of Interests

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