ARCHITECTURAL DESIGN STUDIO ENVIRONMENT AND STUDENT SATISFACTION: CASE STUDIES OF JORDANIAN UNIVERSITIES

ANWAR IBRAHIM[1], SUHA JARADAT[2], MARAM ALATOOM[1]
[1]*Jordan University of Science and technology*
[2]*Edinburgh Napier University*
aibrahi1@just.edu.jo
s.jaradat@napier.ac.uk
maramalatoom2@gmail.com

Abstract. The built environment plays a significant role in shaping users' behaviour and has an impact on their comfort and satisfaction. Of particular interest, the conditions of the built environment in educational places significantly affect the process of teaching and learning. In architectural education, design studios at the heart of any college of architecture. They are places where students spend most of their time nurturing their design skills, growing their imagination, interacting with their colleagues and tutors, producing, and exhibiting their projects. Therefore, special attention should be given to these places in terms of physical design characteristics and layout. Previous research on architectural design studios focused on the curriculum and methods of teaching, as well as the culture of the architectural studio. However, research on physical design and its impact on student satisfaction and performance is scarce. Psychological aspects of these spaces need further investigation. This study aims to evaluate the design studio environment in public and private universities in Jordan. A survey was distributed in six architectural departments to evaluate student satisfaction. Each department is analysed in terms of the spatial layout, accessibility and physical characteristics of the studios. The evaluation criteria adopted a modified version of Guerin's theoretical framework that addresses the built environment in terms of its physical, behavioural and natural criteria. The results showed a moderate satisfaction levels in general and significant differences regarding the level of satisfaction in public and private universities.

Keywords: Architecture, Design studio, Learning environment, User satisfaction, Guerin Framework.

1. Introduction

This study is concerned with the architectural design studio. The design of the built environment plays a significant role in the users' level of comfort and satisfaction (Obeidat, Al-Share, & History, 2012). In learning environments, such as classes and studios, their design has a strong impact on the level of students' satisfaction and performance. According to Cardellino et al. (Cardellino, Araneda, & Alvarado, 2017), learning is an interactive process that is targeting the human and mediated by the built environment. Giving attention to the design of the learning environment is vital in maintaining the quality of the educational process and achieving the learning outcomes. As stated by

Tumusiime (2013), the quality of the learning environment depends on its capability to meet students' needs and maintain their knowledge.

The architectural design studio is an essential place where architecture education mostly takes place (Atakan, 2016). As an educational space, the studio should provide students with a good opportunity to express their ideas and communicate with tutors (Utaberta, Hassanpour, Ani, & Surat, 2011). According to Dixon, studio environment may affect the comfort and satisfaction of students, their productivity, motivation to work, behaviour, as well as the outputs of architectural education (Dixon, 2012). Obeidat et al. (2012) argued that the process of teaching and learning architecture requires a comfortable place which facilitates teaching of various forms including lectures, design projects, and tutorials. As students spend extended times in architectural studios, these need to be exciting and inspiring (Obeidat et al., 2012). Teaching architecture differs from teaching other disciplines in the built environment. Architectural education not only includes practical and theoretical aspects, but also requires an interactive learning environment that supports social interactions (Obeidat et al., 2012).

In Jordan, architectural education is popular and attracts many students. According to the latest research conducted by the Ministry of Higher Education and Scientific Research, there were 4538 architecture students at the end of the academic year of 2018. Jordan is relatively a small country but has nineteen architectural departments. These departments vary in their design, size, location, and environment. Typically, a design studio in these departments is rectangular in shape (Muniandy, Khan, Ahmad, & Sustainability, 2015). Most of the studies that investigated architectural education focused on the curriculum and methods of teaching, in addition to the culture of the architectural studio. However, research on the physical design of the studio and its impact on student satisfaction and performance is quite limited. The aim of this research is to shed light on the architecture learning environment and its impact on student satisfaction. This study examines various public and private architectural departments in Jordanian universities and provides guidelines to improve these environments.

2. Theoretical Framework: Human Ecosystem Guerin Model

Guerin model is a dynamic model that helps researchers to examine various factors and their interactions in a single moment adjusted to variables, organism and time of the study. It is used as a structure to organize and specify variables that assess the interior environments in a simple way. The flexibility of the model helped the authors to choose any number and kind of variables according to their views (Guerin, 1992). This model describes the connection of humans

with surrounding environments, containing the natural, built, and behavioural environments (Guerin, 1992).

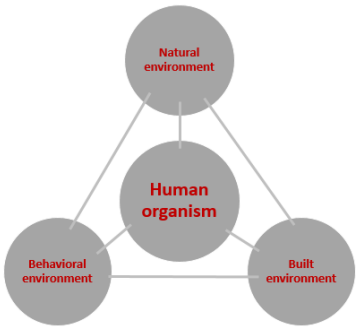

Figure 1. Human ecosystem model. Three environments surrounding the human organism and the mutual relations (Adapted from Guerin, 1992).

As shown in Figure 1, the human organism is at the centre of the model circumscribed by three types of environments; natural, social, and physical. The illustration emphasizes the mutual relations between the environments in addition to the interactions between the human being and these environments (Guerin, 1992). In this research, an adapted version of Guerin model is used to evaluate the level of student satisfaction in their design studios. The adapted model was used by Dixon (2012) to measure the studio environment, within four groups of the three environments (natural, built, and social) in addition to the human being.

HUMAN BEING

The human being is the centre of the model and the user of the surrounding environments. Each person has different characteristics that make him interact with the environment in a different way (Dixon, 2012). The following factors were selected as indicators of the diversity of students' characteristics: gender, GPA and class level.

THE BEHAVIOURAL ENVIRONMENT

Guerin (1992) outlined the behavioural environment by the socio-behavioral, psychological, socio-political, and biophysical aspects of the space. This includes human actions in the environment and the effects of human attitudes, behaviours, and relations in the environment (Guerin, 1992). In this study, the following social and psychological variables were chosen:

- Privacy: the desire to communicate or be isolated from others. In addition to physical accessibility, privacy includes visual and audible access (Dixon, 2012).
- Personal space: a mechanism utilized to support the organization of privacy. It is an active procedure to increase or decrease the distance between individuals and others (Ali Namazian1, 2013).
- Territoriality: the integration of territorial cognition and behaviours of people according to their possession of the physical area (Huang, Mori, & Nomura, 2019)
- Crowding: a sense of restriction, and a feeling that others are violating their own personal space (Dixon, 2012).
- Safety of person: a significant feature which influence the perception of a person about an environment. The risk of safety means that individuals feel threatened in an environment (Dixon, 2012).
- Place identity and sense of place: this refers to how places are linked with the notion of oneself. It may enhance the individual recognition of self-esteem and offers a sense of belonging to the place (Dixon, 2012).
- Sense of community: the desire to preserve the mutual relationship with others by doing what they expect (Dixon, 2012).

3.2. THE PHYSICAL ENVIRONMENT

The built environment is the building envelope that contains building design, materials, surrounding as well as energy systems (Guerin, 1992). The physical environment can be evaluated according to the following:

- Anthropometrics and ergonomics: anthropometrics is “the study of the human body”, including minimum dimensions and areas required for individual requirements when doing various activities (Dixon, 2012). Ergonomics is a domain of the space design regarding the requirements of the human body and the motion of muscles and joints (Dixon, 2012).
- Proxemics: these are included in this study as part of the physical environment. Proxemics assesses the perceptions of space and how the physical environment influences people's behaviours and the level of social communication. Furniture arrangements for example, may increase or decrease social interactions (Dixon, 2012).
- Safety and security of possessions: it may be for example essential to offer secure places to store the possessions of students such as laptops and other tools (Dixon, 2012).
- Flexibility in use: the flexibility of spaces including technologies and creative design that can be adapted to various activities (Dixon, 2012).
- Lighting: natural light and artificial light in learning environments can provide psychological satisfaction (Muniandy et al., 2015).

- Temperature: the ambient temperature of indoor spaces is one of the most important issues affecting the comfort of users (Dixon, 2012).
- Acoustics: this is a very significant feature which affects the users of indoor spaces as noise levels can cause stress in the workplace (Dixon, 2012).
- Personalization and control: the ability of people to control their environments enhance their performance and increase optimism between workers in workplaces (Dixon, 2012).
- Aesthetics: the indoor environment colours and design influences the visual comfort of human beings (Dixon, 2012).

3.3. THE NATURAL ENVIRONMENT

According to Guerin 1992, the natural environment includes climate, resources, plants and water". (Guerin, 1992). Access to landscape and natural light have a positive influence on human well-being (Dixon, 2012).

4. Standards and Recommendations

The architectural design studio environment should meet students' needs. Table 1 summarises some recommendations regarding the design of the architectural studio based on reviewing the literature.

TABLE 1. Recommendations regarding the design of architectural studio.

Issue	Recommendation
Lighting (Access to natural light, windows orientation, window floor area)	1- It is preferable to use both natural lighting (side or ceiling) and artificial lighting in educational spaces (Neufert, Jones, & Thackara, 1980), The lighting should be evenly distributed within the architectural studio (Zaza & Ziad, 2014). 2- North-facing windows are recommended to obtain equal daylight in the studio (Neufert, Neufert, Baiche, & Walliman, 2000). It is preferable to provide windows from both sides and use the appropriate shading (Demirbas & Demirkan, 2000). 3- Studios need windows equal to at least 25-33% of floor area with North or East sides (Neufert et al., 1980).
Views and access to nature	4- The architectural design studio should provide visual comfort and a view of quiet green areas (Muniandy et al., 2015). 5- In order to achieve the quality of the design studio environment, the building should be integrate with the landscape (Aderonmu, 2016 #31).

Issue	Recommendation
Furniture (flexibility, sense of community, personal space)	6- Furniture and tools in learning environments must be comfortable and designed with a high level of flexibility to be adjusted (Dixon, 2012). 7- The studio must be adaptable for several activities such as seminars, lectures, design work or presentation. This can be achieved by the flexibility of furniture and the existence of partitions to create different areas (Zaza & Ziad, 2014). 8- The architectural design studio should support the social interactions (Obeidat et al., 2012), by providing small group workspaces to encourage social activities (Muniandy et al., 2015), or by including side-to-side and face-to-face furniture arrangements (Dixon, 2012). 9- The architectural design studio should also provide students with different options that allow them to work with others or individually (Dixon, 2012).
Environmental conditions (temperature, ventilation)	10- It is recommended to allow individuals to control environmental conditions such as ventilation, lighting, and temperature. (Ibem, Owoseni, & Alagbe, 2017) 11- The ideal temperature degree for learning environments is 68 and 74 degrees Fahrenheit (Cheryan, Ziegler, Plaut, Meltzoff, & Sciences, 2014).
Layout, design, shape (territoriality, privacy)	12- In design studios, barriers like walls, doors, and partitions in workplaces create a sense of privacy and help individuals or groups to control their contact with others (Hua, 2010) 13- Open-plan studio spaces are noisy, and an increased need for visual and acoustical privacy (Dixon, 2012). While it reduces the sense of crowding (Ibem et al., 2017).
Colors	14- In learning spaces, it recommended combining bright colors with neutral colors to create an attractive environment (Dixon, 2012). 15- White color is a neutral color with vital advantages for space users. However, It may generate feelings of carelessness and tedium (Dixon, 2012).
Connectivity and building location	16- The studio should be located in a safe location with a welcoming area visible and easy to reach, providing natural lighting and ventilation, outdoor spaces, and green spaces, as well as linking the inside with the outside(Muniandy et al., 2015). 17- It advised offering wayfinding techniques in the walkways like signs and numbering systems (Dixon, 2012).
Area and crowding	18- The number of students in the architectural design studio should not exceed (17-18) students in the studio with an appropriate area of 70 m² (Zaza, 2014 #7). 19- The square room gives a sense of less crowding than the rectangular one (Ibem et al., 2017).
Technology (flexibility)	20- Digital technologies and various modern means of technology should be integrated into design studios (Obeidat et al., 2012).
Student area	21- Space should provide for each student architectural design studio ranging from (3.5-4.5) m² (Neufert et al., 2000).
Spaces between (proxemics	22- It recommended the drawing table provide comfort to students with size between (1.4-2.20m * 0.80-1.25m) (Neufert et al., 2000)
Safety and security	23- It recommended providing secure storage for students' personal belongings near the studio (Obeidat et al., 2012)

5. Methodology

This study aims to provide an evaluation of the design studio environment in various public and private architectural departments in Jordanian universities. It also aims to propose guidelines to improve these environments. Literature review was conducted to collect the optimum design requirements of learning environments. In addition, the study adopts a modified version of the theoretical framework of Guerin (1992) that addresses the built environment in terms of its physical, behavioural and natural criteria. Physical criteria include the building's envelope, site integration, energy systems, and design. Behavioural environment criteria include the socio-behavioural and psychological characteristics of the space. The natural environment criteria include access to nature, view and natural light.

Six architectural departments in three public and three private universities were randomly selected to conduct the survey and to analyze their environments. Each department was physically analysed in terms of its spatial layout, accessibility and physical features of the studios. A field survey using a structured questionnaire with a Likert Scale was distributed to the architecture students in each department to evaluate their level of satisfaction of these studios. The evaluation criteria were based on a modified version of Guerin theoretical framework.

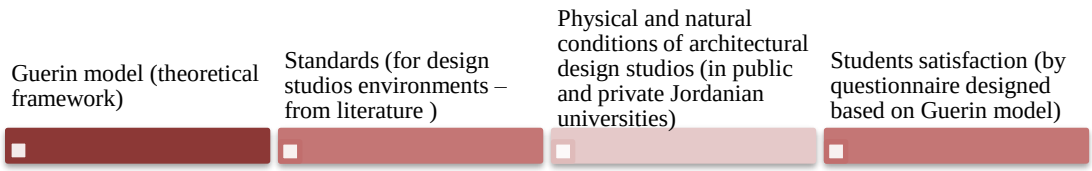

Figure 2. Methodological procedure.

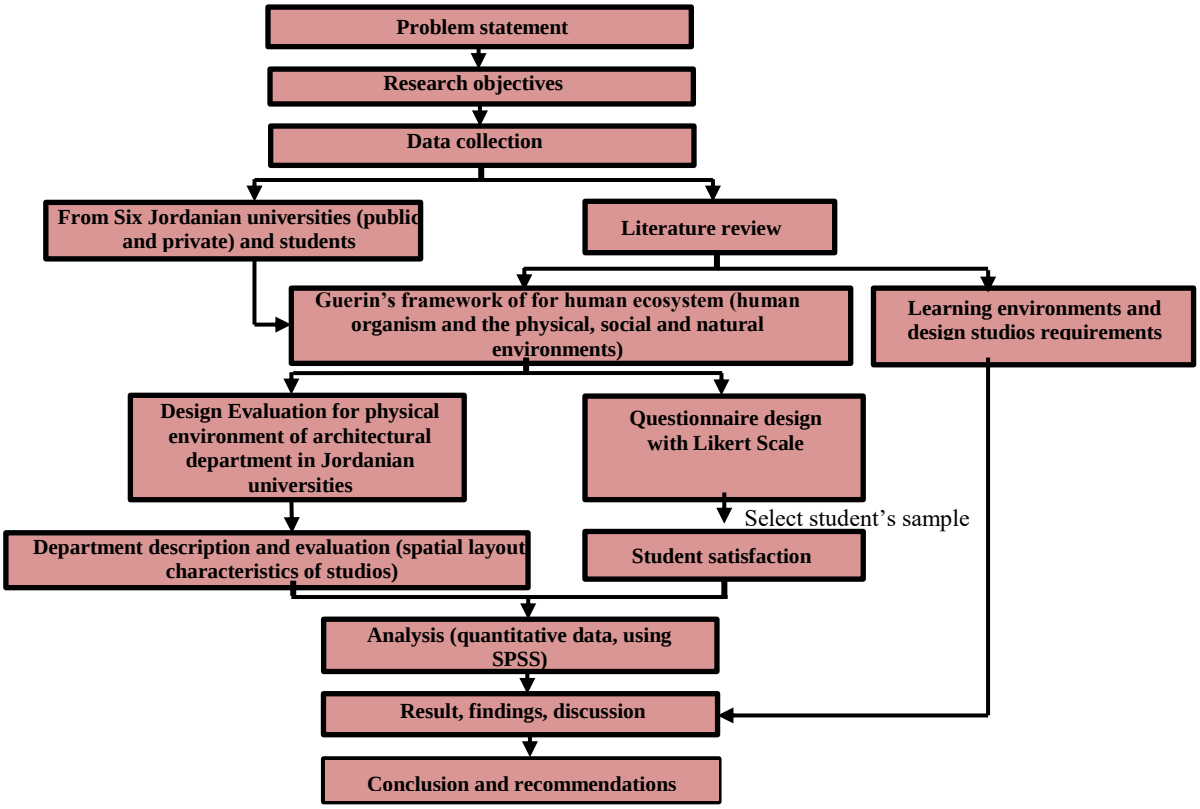

Figure 3. Methodology flow chart.

5.1. EVALUATION TOOL

The study used a questionnaire to collect data from students about their architectural design studio environment and their satisfaction within these studios. An evaluation tool was developed based on previous studies and Guerin framework. The developed questionnaire was designed to measure the level of student satisfaction and contained five sections: general biographical information, students' characteristics (screening ability, introvert vs. extrovert), 33 six-Likert scale items related to the physical environment of the studio, 15 six-Likert scale items related to the social environment of the studio, and 4 six-Likert scale items related to natural environment in the design studio. The six-point Likert scale indicated the degree of approval about their level of satisfaction in their design studio environments.

5.2. SAMPLE

Six Architectural departments in six public and private universities in different governorates of Jordan were randomly chosen based on their location, accessibility, and having various types of studios.

5.3. PROCEDURE

A total of 530-paper questionnaires distributed among the undergraduate students of architecture from first year to fifth year in all targeted universities, 495 of them were considered for analysis.

This questionnaire was designed according to the variables in the Guerin framework and divided into four sections about the human being, physical, social and natural environment. The questionnaire started with general questions about the university, age, year, and gender. After the introductory questions, there was 59 short closed questions followed by six points Likert Scales to indicate the degree of approval from strongly disagree to strongly agree.

6. Analysis and results

Each architectural design studio in each department of the selected universities was analysed in terms of the spatial layout of the college (or department), accessibility and physical characteristics of the studios. The total number of the evaluated studios was twelve. Table 2 summarises the general environmental characteristics of the selected studios.

TABLE 2. General environmental characteristics of the selected studios.

University	Studio	Students / studios	studio shape	Student area	Windows – floor area	Artificial cooling-heating	Views	Drawing boards arrangement	Technology	Walls colours
1	1	15-22	rectangle - closed plan	9 m²	5-10 %	F, C	B	rows	data show, computer, Wi-Fi	pale apricot, white
	2	15-22	rectangle - closed plan	9 m²	5-10 %	F, C	B	rows	data show, computer, Wi-Fi	pale apricot, white
2	3	26-32 (2 groups)	T shape - semi closed plan	7 m²	5-10 %	C	G	rows	data show, Wi-Fi	light grey, white

University	Studio	Students / studios	studio shape	Student area	Windows – floor area	Artificial cooling-heating	Views	Drawing boards arrangement	Technology	Walls colours
	4	26-32 (2 groups)	T shape - semi closed plan	7 m²	5-10 %	C	Mix	rows	data show, Wi-Fi	light grey, white
3	5	25-30	rectangle, closed plan	2.5 m²	15-20 %	A	Mix	rows	data show,	light blue, white
	6	80-90 (4 groups)	rectangle-open plan	3 m²	15-20 %	A	N	rows	data show,	light blue, white
4	7	17-22	rectangle-closed plan	4 m²	15-20 %	F, C	B	rows	data show, computer, Wi-Fi	light blue
	8	17-22	rectangle-closed plan	4 m²	5-10 %	F, C	B	rows	data show, computer, Wi-Fi	light blue
5	9	15-18	rectangle-closed plan	5.5 m²	15-20 %	F, C	Mix	rows	-	White.
	10	15-18	rectangle-closed plan	5.5 m²	15-20 %	F, C	Mix	rows	-	White.
6	11	11-13	rectangle-closed plan	9.5 m²	5-10 %	F, C, A	Mix	U-shape	data show, computer, Wi-Fi	White.
	12	11-13	rectangle-closed plan	9.5 m²	5-10 %	F, C, A	Mix	U-shape	data show, computer, Wi-Fi	White.

*View, (B: Built environment, N: Natural environment, Mix: both built environment and natural environments)
*Artificial heating and cooling, (F: Fans, C: Central heating unit, A: Air conditioning)
1: Yermouk University, 2: Jordan University of Science and Technology, 3: Balqa Applied, 4: Amman Ahliyya, 5: Zarqa Private, 6: Applied Sciences.

The Statistical Package for Social Sciences software (SPSS, version 19, Chicago. Inc) was used for data processing and analysis. Characteristics of subjects' variables were described using frequency distribution for categorical variables in addition to mean and standard deviation for continuous variables. Group comparisons were conducted using the t-test. Frequencies were expressed in percentages. Statistical significance was set at $P<.05$. Table 3 gives a general statistical description about the sample in terms of gender, academic level and GPA. The total number of participants was 495 students; 35% are from private universities and 65% are from public universities.

TABLE 3. General statistical description of the sample (N=495).

Variable	**No.**	**Per.**
Gender		
Male	202	40.8
Female	293	59.2
Academic level		
1	98	19.8
2	109	22.0
3	129	26.1
4	95	19.2
5	64	12.9
GPA		
50-59	29	5.9
60-69	116	23.4
70-79	190	38.4
80-89	141	28.5
≥ 90	19	3.8

Regarding the general evaluation of students satisfaction, students were rather satisfied regarding the three indicators of the physical environment. The mean of their general satisfaction on the three indicators was 3.603, see Table 4 and Figure 4.

TABLE 4. Mean and standard deviation of studio physical environment satisfaction.

Student satisfaction	Mean	Standard Deviation
Physical environment	3.419	0.764
Behavioural environment	3.846	0.826
Natural environment	3.571	1.152
Design studio environment general satisfaction	3.603	0.736

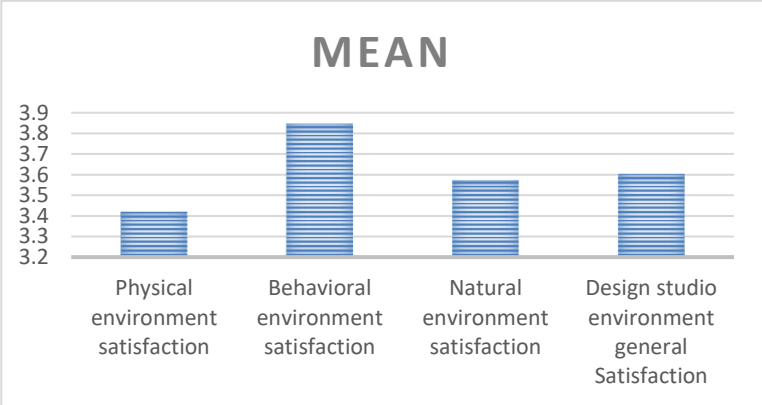

Figure 4. Mean of students' satisfaction in physical, behavioural and natural environments in addition to the general satisfaction in design studios environment.

Students in private universities showed higher level of satisfaction than those in public universities, see Table 6. Figure 5 shows the mean of student satisfaction in physical, behavioural and natural environments in addition to the general satisfaction in design studios environment according to university type.

TABLE 6. The effect of university type on studio environment general satisfaction (mean ± Std. Deviation).

University type		Physical environment satisfaction	Behavioural environment satisfaction	Natural environment satisfaction	Design studio environment general Satisfaction
Public	Mean ± Std. Deviation	3.322^{b} ± 0.740	3.762^{b} ± 0.805	3.393^{b} ± 1.098	3.503^{b} ± 0.723
Private	Mean ± Std. Deviation	3.599^{a} ± 0.777	4.004^{a} ± 0.843	3.903^{a} ± 1.179	3.790^{a} ± 0.725
P-value		0.000	0.010	0.000	0.000

Notes: All values are $\bar{y}$ ± SEM.

Different subscripts indicate statistical difference across categories of each variable

Figure 5. Mean of student satisfaction in physical, behavioural and natural environments in addition to the general satisfaction in design studios environment according to university type.

7. Discussion

As shown in the analysis above, the students are reasonably satisfied as the studios offer both natural and artificial lighting which provide psychological satisfaction (Muniandy et al., 2015). Furthermore, the furniture and its dimensions are appropriate and suit the students' needs. Most of the seating and drawing boards were arranged in rows. Such an arrangement satisfies proxemics' demands by giving each student his private space (Dixon, 2012). Because the furniture is not fixed, this flexibility allows easy furniture re-arrangement to perform various tasks and activities in the studio space (e.g. tutorials, lectures, presentations, and working on design projects). The availability of technological devices such as computers, projectors, and wireless connection makes the studio a convenient educational area for students. Providing a thermally-comfortable studio environment was achieved by installing central heating units and electric fans for cooling. The ability to control heating and cooling systems enhances students' performance levels and satisfaction (Ibem et al., 2017).

In terms of the spatial layout, the majority of studios have a closed plan system which decreases levels of noise (Dixon, 2012). In addition, most

departments provide personal safety including fire safety, location, noise levels, wayfinding, visibility of studios, and proximity of W.C.

Students are somewhat satisfied in terms of the natural environment of studios because most of the studios face the north and south which provide natural lighting. North-facing windows are best to obtain equal daylight in the design studio (Neufert et al., 2000). It is also recommended to provide windows from two sides to reduce glare (Demirbas & Demirkan, 2000).

Students are to some extent satisfied with the behavioural environment of studios because a large number of studios provide privacy, personal space in addition to safety. Studios designed in rectangle shape provide students with area between (5.0-9.5 m^2) for each student which decrease the sense of crowding. Finally, studios provide a sense of community and facilitate social relations between students.

The results show that students were dissatisfied with the physical environment of design studio. Although these studios in general provide good amenities, they suffer from a number of shortcomings in relation to the fixed and non-fixed physical elements. For example, most universities have window-wall area ratio between 5-10%. This ratio should be between 25-30% (Neufert et al., 1980). The stools used in these studios are uncomfortable and non-adjustable seats. Despite the fact that the furniture arrangement in rows provides students with personal space and privacy, this kind of arrangement is considered anti-social. Small group workspaces encorage social interaction (Muniandy et al., 2015). According to Dixon (2012), the studio should provide both types of arrangement and give students the choice to sit individually or in groups. Regarding colours, all studios visited in the study were painted using white or light colours. According to Dixon (2012), the colours in the design studios should include bright and neutral colours which provide visual comfort for users (Dixon, 2012). Additionally, most of the visited studios are facing buildings. Overlooking natural environment and green areas have a positive impact on human wellbeing (Muniandy et al., 2015).

The results show a significant difference between public and private universities. The studios of private universities are in better physical conditions than those in public universities. All the studios in private

universities are rectangular in shape and the closed plan system decreases the level of noise and provides more privacy. The studios in the selected public universities have various shapes including open plan, semi-closed and closed systems.

Besides, the studios in the selected private universities have lower number of students which decreases levels of crowding andincreases levels of satisfaction. In contrast to many public universities, all private universities also provide better thermal comfort conditions by installing Heating, Ventilation and Air Conditioning (HVAC) systems. In addition, the furniture arrangement in some architectural studios of private universities in Jordan is U-shape arrangement which increases the social interaction, sense of community, and sense of belonging. The majority of private universities' walls were painted in white which has provides visual comfort for users.

8. Recommendations and conclusions

The design studio is considered as a living-learning environment for architectural students. It is the space where architectural student spend extended times performing various socio-educational activities. Therefore the studio should meet the needs of the students. Careful attention should be given to the design of the studio to increase the level of productivity, creativity and satisfaction of the students.
This study offers a few recommendations to enhance student satisfaction. Rectangular shape with a closed plan system is recommended with natural and artificial lighting. The arrangement of furniture should be flexible to allow students to work individually or in groups. Each student should be allocated more than (4 m^2). Natural heating and cooling with HVAC systems should be provided. The maximum number of students in a studio shouldn't exceed 17. Seating should be flexible and comfortable and desks dimension around (1.2 * 0.80 m). Painting the walls in white or mixing white and bright colours is recommended in addition to providing views of natural environments.

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