Architecture Post COVID-19

On 18 March 2020, the World Health Organization announced that the coronavirus disease 2019 (COVID-19) pandemic had reached 9 global pandemic status. The Ministry of Health in Saudi Arabia implemented a COVID-19 lockdown that lasted for four months. After the period of restrictions ended, people were supposed to return to their normal social lives; however, the lockdown had a psychological impact on people without them being aware of it. This research aimed to study the effect of COVID-19 on social life, mainly focusing on six public activities: visiting shopping malls, mosques, open spaces, interior space, psychological effect and occupational aspects. The Method survey was distributed during lockdown including the six focus areas and collected using Google Forms. Also, a computer program simulation (ENVI-MET) was used to study and develop an outdoor environment. The research focuses on the outdoor environment to find solutions on a sample used Al Rouda Park in Riyadh.

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Scholars' Press

Dr. Hind Abdelmoneim Khogali

Architecture Post COVID-19

Architecture, E-Learning, Interior, Graphic Design

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DEDICATION

In His Holy Book, the Almighty Allah mentioned: **"And says (unto Act! Allah will behold your actions, and (so will) His messenger and the believers, and you will be brought back to the Knower of the Invisible and the Visible, and He will tell you what you used to do"** (Surat Al-Tawbah. 105); and He mentioned: "**And We have enjoined Upon man concerning his parents - His mother beareth him in weakness Upon weakness, and his weaning is in two years - give thanks unto Me and unto thy parents. Unto Me is the journeying**" (Surat Luqman, 14). This dissertation is dedicated to my beloved mother Mrs. Al-Sareerah Mohammad Ata-Almanan. I cannot find more eloquent words than Prophet Mohmmad's words Peace Be Upon him as he mentioned: "**Who is the most worthy of your company? He mentioned: Your mother. Then, he added: Your mother and added: Your mother, then, your father**". My dear father, Engineer Dr. Abdel Moneim Khogali, who worked and struggled until his name flew up in the sky of Sudan. His plant has produced delicious fruits literally speaking. I pray Almighty Allah to watch over him, protect him, and bestow upon him His blessings and bounties. It is a great honour and source of ultimate happiness to me to dedicate this effort and dissertation to my beloved parents, in recognition of their love and care. I also dedicate this effort and dissertation to my respectable beloved husband, Dr. Al-Fatih Mohi Al Dein. I cannot forget, and I appreciate your endless and relentless support and love. I also dedicate this work and dissertation to my beloved children: Muhammad, Momen, Mazin and Noon. This work should be a guiding light for you to follow on the path of knowledge and learning

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اطع الإله كما أمر وملأ فؤادك بالحذر

وأطع أباك لأنه رباك في عهد الصغر

وأخضع لأمك حقوقها عند الكبر.. لأنها حملتك تسعه أشهر بين التمرض والضجر.. فإذا مرضت فإنها تبكيك بدمع كالمطر

Obey God as He commanded, and fill your heart with caution and obey your father because he raised you when you were young And submit to your mother her rights when she is old...because she carried you for nine months between sickness and boredom.

Bio:

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1. My website www.hindamkh.blogspot.com
2. **https://sites.google.com/d/1k4D37HXAitHSihQdjQhNppSLpJzVSqdK/p/10_ GhdFwiVQYuYAcSYtWlRpQbtLa3zA3I/edit**
3.
4. **Research gate, Hind Abdel moneim https://www.researchgate.net/profile/Hind_Abdel_moneim?ev=hdr_xprf&_sg =KghtHqizOFxUKtLD- GaPxlaEWEmBqTVl9HN1KBj5DbkQxokASq_tQ65Zf_7QjXiEeIeWKW8Of hF4sHu-LXQ2qtq3**
5. **LinkedIn Hind Abdel Moneim** https://www.linkedin.com/in/hind-abdelmoneim-khogali%D8%8C-ph-d-b80ab43b/

4. **Channel 1)** https://www.youtube.com/feed/my_videos
Channel 2) https://www.youtube.com/feed/my_videos

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CHAPTER ONE

The Effect of COVID-19 CORONA VIRUS on Sustainable Teaching and Learning in Architecture Engineering

The Effect of COVID-19 CORONA VIRUS on Sustainable Teaching and Learning in Architecture Engineering

Khogali, H., 2020

Abstract

On 11 March, the World Health Organization (WHO) announced that the COVID-19 outbreak became a global pandemic. The governments have been implementing measures to limit the number of people congregating in public places. Therefore, the Ministry of Education stated that all educational institutes should complete the 2019-2020-2 semester using online video conferences and virtual classes. The aim of this research is to study the effect of COVID-19 on teaching and learning during the last three months of lockdown after shifting to virtual classes. The research study the procedures applied by the College of Architecture Engineering in Dar Al Uloom University. The Adding value is improving the E-Learning process for the upcoming semesters and solving the negative points for a better education. To achieve this objective the researcher, distribute a survey to the students to scale their experience and record the positive points, and to find a solution to the negative points to solve these problems. The outcome of the research showed a good experience and many recommendations to be applied in the coming future.

Keywords: teaching and learning on architecture engineering colleges, develop the learning outcome, the effect of COVID-19 on teaching and learning.

1.1 1. Introduction

On 11 March, the World Health Organization (WHO) announced that the COVID-19 outbreak became a global pandemic. Congruent with the directives of the Ministry of Education and stemming from Dar Al Uloom University continued commitment to quality education, and to bringing the academic term to a successful conclusion, different procedures have been applied. On 15 March, the university sent an official email to all faculty members to complete the semester using the Microsoft team in the virtual classes,

the Learning Management System (LMS), and the university email to communicate to the students. The following procedures have been implanted by the college of Architecture Engineering in Dar Al Uloom University:

1.1 Develop the Courses Syllabus

a)   Total Grade distribution: 80% for the pre-final continuous assessment, and 20% for the final exam.

b)   The midterm exam and the final be conducted online through the LMS.

c)   All the assignments should be uploaded in the LMS.

d)   The design studio projects should be discussed virtual in the Microsoft team program.

e)   The teacher can use the whiteboard for further explanation to the students (see table 1).

1.2 Develop the Course Learning Outcomes

The college of Architecture Engineering started comprehensive workshops for the faculty members on developing the program and course learning outcomes. The focus of the research will be on the History of Architecture, Landscape, Sanitary, and Technical and Environmental Control courses.

Table 1.1. Show the development of course assignments with the course learning outcome.

Course Learning Outcomes in Domains of Learning and Alignment with Assessment Methods and Teaching Strategy								
Code #	*Learning Domains And Course Learning Outcomes*	*Assig# 1*	*Assig# 2*	*Assig# 3*	*Assig# 4*	*Assig# 5*	*Mid Term*	*Final Exam*
1.0 1.1.1	Knowledge Outline technical and aesthetical solutions for site/landscape projects through comprehensive integration of different technical operations.						●	●
2.0 2.0.1	Cognitive Skills Identify design problems providing their solutions with sensitivity to technical, esthetical, social and built	●	●	●	●	●		

Code	Description							
	environment aspects, through analysis, criticism, and potential resolutions.							
3.0	Interpersonal Skills & Responsibility					•		
3.0.1	Illustrate the ability of problem-solving and critical thinking in both individual and group discussions.	•	•	•	•			
4.0	Communication, Information Technology, Numerical							
4.0.1	Communicating the project and the design process through IT relevant specific graphic design programs (Photoshop, AutoCAD, 3D Studio).	•	•	•	•	•		
5.0	Psychomotor							
5.1.1	Produce an overall comprehension of building facilities details, plumbing details, or building components for a particular architectural design.	•	•	•	•	•	•	•

1.3 Develop the Course Content

i.   Landscape and urban design course

a)   All courses achieved the knowledge in midterm, exams, and final exams.

b)   Cognitive skills are achieved by five weekly assignments, analyzing case studies in the local and international landscape and gardens, and analyzing the design studio site.

c)   Interpersonal skills are achieved by uploading all the assignments in LMS.

d)   Communication skills are achieved by encouraging the students to discuss their assignments through the virtual classes during the lectures. The discussion is directed by the teacher and sometimes between the students in groups.

e)   The Psychomotor skills in the design and draw are achieved through the AutoCAD program (the semester small project of the landscape).

f)   The teaching method is done by using the PowerPoint presentation.

g) Continuous evaluation is given to the student in LMS and during the lecture. Feedbacks from the students is obtained at the end of the lecture.

I. History of Architecture course

a) The knowledge is achieved in the midterm, short exam, and final exam.

b) Cognitive skills are achieved by five weekly assignments, analyzing case studies in the history of Middle Ages and pre-historic architecture, and compare between different eras.

c) Interpersonal skills are achieved by uploading all the assignments in LMS and attending the virtual class on time.

d) Communication skills achieved by encouraging the students to discuss their assignments through the virtual classes during the lectures. The discussion is directed to the teacher and sometimes between the students in groups.

e) The Psychomotor skills in drawing sketches are achieved at home. The sketch is submitted in LMS.

f) The teaching method is done by using the PowerPoint presentation.

g) Continuous evaluation is given to the student in LMS and during the lecture.

II. Sanitary and technical course

a) The knowledge is achieved in the midterm, short exam, and final exam.

b) Cognitive skills are achieved by five weekly assignments, design and draw through the AutoCAD program (the semester design projects), and apply the sanitary and technical on them.

c) Interpersonal skills are achieved by uploading all the assignments in LMS, attending the virtual class on time.

d) Communication skills are achieved by encouraging the students to discuss their assignments through the virtual classes during the lectures. The discussion is directed to the teacher and sometimes between the students in groups.

e) The Psychomotor skills in the design and drawing are achieved through the AutoCAD program at home. The sketch is submitted in LMS.

f) The teaching method is done by using the PowerPoint presentation.

g) Continuous evaluation is given to the student in LMS and during the lecture. The Rubric is used and given to the students.

III. Environmental control

a) All courses achieved the knowledge in midterm, short exams, and final exams.

b) Cognitive skills are achieved by five weekly assignments, analyzing case studies in local and international levels, analyse Riyadh climate, and draw a sketch of the courtyard system and wind tower.

c) Interpersonal skills are achieved by uploading all the assignments in LMS and student research group work.

d) Communication skills is achieved by encouraging the students to discuss their assignments through the virtual classes during the lectures. The discussion is directed by the teacher and sometimes between the students in groups.

e) The Psychomotor skills are achieved through drawing a sketch of wind tower and courtyard system

f) The teaching method is done by using the PowerPoint presentation.

g) Continuous evaluation is given to the student in LMS and during the lecture.

1.4 Develop the Student Learning and Management System (LMS)

The Quality Unit provided a comprehensive workshop to DAU Staff explaining the eight standards of E-Learning and stated that faculty members should develop his/her LMS page, everything should be clear for the student, we should upload the course syllabus, course specification, lectures, online exams, and student manual.

1.5 The Objective of the Paper and the Add It Value

The main objective of the paper is to study Dar Al Uloom University experience during the three months in the E-Learning and the virtual classes. The Adding value is improving the E-Learning process for the coming semester and future, and solving the negative points for a better education. To achieve this objective the researcher used a survey to scale the students' response to this experience and record the positive points and the negative points, and suggest a solution to solve these problems. We must improve our experience especially after the announcement WHO that COVID-19 became an outbreak.

1.2. Research Method

The research is quantitative research based on a survey distributed to the students in architecture college. The survey tool is used to record their response towards teaching and learning in the virtual classes. It is made using the Google Forms and sent to 54 students after they completed their final exams during the time between 10/May/2020 and 20/May/2020. The survey contains 15 questions, including 5 categories, general information, the response of the student about design studios and theocratical courses, the technical problems facing the students during the virtual class, health problems, the response of students towards the method of assessment.

A qualitative interview was done in virtual classes to record the response of the students especially in the problems facing them. Most of the students facing health problems in their eyes and back because of ling classes about 6 students they do not have laptops.

A Comparison between Dar Al Uloom University experience and Yarmouk University experience in Jordan was done in virtual meeting (Webinar S. R., 2020), they said that they have the same experience in the E-Learning and virtual classes, they added two points: the first point is that the total number of the students in the class should not exceed 20 students. The second point is the students in the first year in Architecture school need more time and effort to learn them the basic engineering drawing, they solve this problem by giving them easy exercises during the COVID-19 time and concentrated in isometric drawings.

1.3. Literature Review

3.1 Medical Support

(Solution, 15-5-2020) stated that COVID-19 affected employees' wellbeing and business continuity. It affected the building system, interior design space, housekeeping, nourishment and fitness, architectural design, plumbing and bathroom design, innovative technologies, political, and standards. Therefore, post-COVID-19 workplace strategies were made in order for the employee to be safe. The solutions can be in using HVAC systems and air circulations, social distancing in the interior design places, using smart solutions in the public spaces and in the bathrooms. (WHO, 2020) announced that COVID-19 became a global pandemic, and this has affected our social life, health, and education.

The Saudi Center of Disease Pretension and Control, (Control, 2020), published a report on how we can control the COVID-19 spread. They said that institutions should follow the standard precautions, which include:

- Mask should be available.

- Regular check the soap and the sanitizing bottle in its places. The hand Sanitizing should be near the door and in the main halls and in the bathrooms that everyone can found it and use. Signs and orientations for COVID-19 should be posted near it.
- Avoid direct contact with blood, body fluids, secretions (including respiratory secretions). Standard precautions also include prevention of needle-stick or sharps injury.

- Safe waste management; cleaning and disinfection of equipment, and cleaning of the environment.

- Using eye protection (facemask or goggles), because sprays of secretions may occur.

- Limit infected person movement within the institution and ensure that they wear a medical mask when moving around.

- Ensure that there are healthcare workers to perform aerosol-generating procedures for emergency cases (i.e. open visit suctioning of the respiratory tract, high-flow nasal oxygen, non-invasive ventilation, intubation, bronchoscopy, cardiopulmonary resuscitation. In addition, the Saudi Center of Disease Pretension and Control published a report to show the general steps that should be done by peoples.

The social distancing as a method of reducing the spread of Covid-19 have resulted in productivity losses, disruption in business, and may cause a cost impact in the long term, according to (MEED, 2020). The key is how that record is maintained and how it is going to be produced to substantiate the claim. The social distancing has affected some courses in architecture college that require a site as a part of learning procedures and learning outcome. These courses are building construction, design studio, construction document, landscape, and urban, and urban design.

3.2 Training and Lectures Support

UNESCO's said that COVID-19 tells us the scientific cooperation is the key when dealing with a global public health issue. It tells us that continued education must be ensured when so many children today cannot go to school. It is a stark reminder of the importance of quality, reliable information, at a time when rumors are flourishing. It tells about the power of culture & knowledge to strengthen human fabric and solidarity, at a time when so many people around the world must keep social distance and stay at home. UNESCO is fully committed to supporting governments for distance learning, open science, knowledge, and culture sharing as a fundamental means to stand together and tighten the bonds of our shared humanity, (UNESCO, 2020). Following the UNESCO orientation due to the extraordinary circumstances that the world is witnessing after the COVID-19 outbreak, it became crucial to continue the education online and make it happen. According to (SRF_Webinar, 2020), they said the institution should develop the skills of E-Learning for the faculty members by doing workshops and training program and continuous education for faculty members and built the learning environment. The University of Dar Al Uloom provided three workshops during 30/July/2020 about the E-Learning Standards Applying the Quality Matters Rubric (APPQMR, 2020)", the workshops explained the eight standards of the E-Learning to improve the online teaching and learning process for the next semester. During the workshop they recommended two websites to visit: (1) Universal Design for Learning (UDL, 2020). They set a guidelines and framework for learning to provide multicable means of learning in engagement, responsibilities, action and experience. (2) Web Content Accessibility Guidelines (WCAG, 2020). It covers a wide range of recommendations for making web content more accessible for a wide range of people.

Robert, J Howlett published a book in 2019 named "Smart Education and the E-Learning", (Robert, 2019). In chapter four he talks about the students' virtual collaborative

engagement, while in chapter eight he talked about developing students' research skills, using of LMS system to communicate with the students.

Sonia Patel wrote an article about "the Top 6 eLearning Trends Of 2019", (Patel, 2019). She stated that eLearning is getting bigger and better. It seems there is no stop—we are being creative and innovative like never she said that the top 6 e-learning trends are: microlearning, artificial intelligence, gamification, adaptive learning, video, and mobile learning. These trends have excelled themselves this year, making eLearning much more learner-centric and more interactive in the virtual classes.

It is important for the students in the virtual class to be engaged in the lecture and the discussion. Dr. Muhammed Alhasan Abdullah said in his webinar on YouTube, June 8, (SRF-Webinars, 2020), to achieve this, engagement should be self-directed, task-oriented, goal oriented, and should be between the teacher and the student or between the students themselves in groups. Additionally, Dr. Maysara Issa Mohiuddin said in his webinar on YouTube, May 29, (SRF-Webinar, 2020), the effective learning should be student centred, two-way discussion, continuous evaluation and feedback, per- reflection, interaction engagement, and this could be achieved by different teaching methods such as groups discussion, pair discussion, groups presentation, sharing conference lectures between male and females in the conference room.

It is important to receive feedbacks from the students about the online classes to take the positive and manage the negative points. A research published in WILEY library entitled "Audio peer Feedback to Promote deep Learning in Online Education investigated the relationship between providing and receiving audio peer feedback with a deep approach to learning within online education" stated that students may be supported by online audio peer feedback as a method to choose a deep approach to learning, (Renée M. Filius1, 17 March 2019).

3.3 Technical Support

The college of Business in Dar Al Uloom University, (Buisness, 2020), announced the following rules for electronic exams;

▪   The exam will be conducted at home because of COVID-19.

▪   The teacher should manage the online exam on the Student Learning Manage System (LMS).

▪   The exam should have a student password.

▪   The student should be in the Microsoft team room during the exam duration and other regulations according to the university's online exam rules. The Information Technology Support (Support, 2020) published a booklet to orient the teachers about the online exams followed by a workshop for the faculty member on Microsoft Teems Program.

▪   Every student should have a laptop, operation system windows vista 10, Google Chrome, Microsoft teams on desktop.

▪   The online exam should be a one-way exam the student should answer the questions and go forward, it is not allowed the student to go back.

▪   The questions have limited time to be answered to avoid any plagiarism.

▪   The IT should provide student manual for the students and for the teachers in How they can use the LMS, everything should be clear to the student and to the teacher in How they can upload their assignments, How they can make their online exams, How they can see their continuous at the end of the semester

▪   The teacher should upload all the materials in the LMS including the PowerPoint presentation, videos, e-books, supporting Links from the internet, announcements, photos and tables.

3.4 Research Support

Ms. Alia Ahmed in the National College of Business Administration & Economics in Pakistan stated that their experience on the online classes was excellent, and they did not miss even one class, (Alia AhmedAltaf-ur Rehman, 2020). They distributed 4 surveys to measure the experience, kept on working as a team, and eventually things started shaping up and settling down. The report concluded that staff maintaining their high and lively spirit as usual, for being so brave and optimistic in the face of this virus-ridden situation. However, a view of the data also points out that a hybrid teaching solution of in-class and online teaching will need to be deployed and going forward. A hybrid solution mandates an LMS, customized to our institution. As mentioned earlier COVID-19 may just prove to be the turning point towards a "digital world". (Admiraal, May 2020) stated that we should use technologies in teaching and learning, and focus on learning not teaching concentrate on active learning.

4. Research Results

At the end of the semester, a survey was distributed to the students in five courses; Landscaping, History of pre-Historic Architecture, History of Middle Ages, Sanitary and Environmental control. The result of the survey is shown in Figure 1.5 to Figure 1.16.

Figure 1.5. Shows the level of study
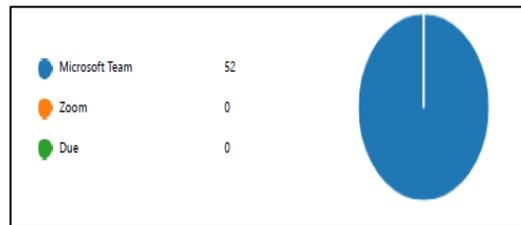
Figure 1.6. which program you used?
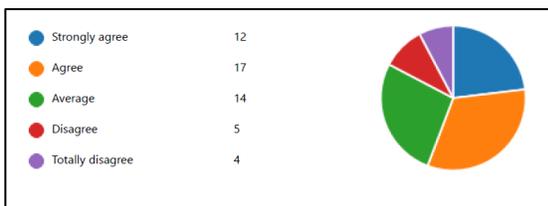
Figure 1.7. Do you think your experience with the online learning was effective?
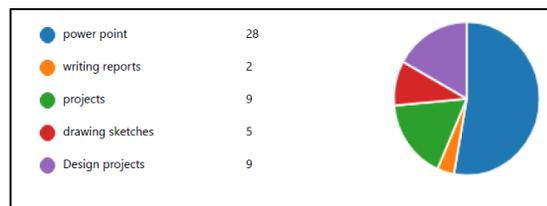
Figure 1.8. Which type of exercise was more effective?
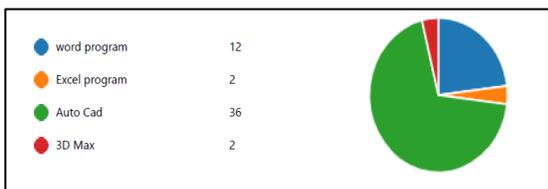
Figure 1.9. Which program you used in the assignments?
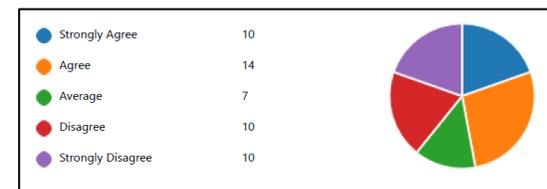
Figure 1.10. How do you describe your experience with the Design Studio in the online classes?
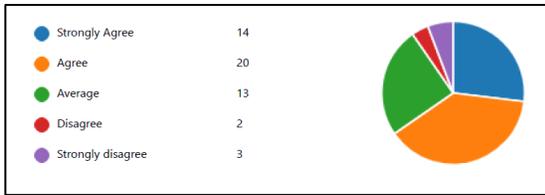
Figure 1.11. How you describe your experience with the theoretical courses like landscape, history of architecture, Environmental control, and Sanitary

Strongly Agree	14
Agree	20
Average	13
Disagree	2
Strongly disagree	3
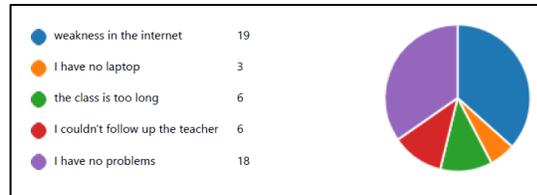
Figure 1.12. During the online class, did you face any technical problems?

weakness in the internet	19
I have no laptop	3
the class is too long	6
I couldn't follow up the teacher	6
I have no problems	18
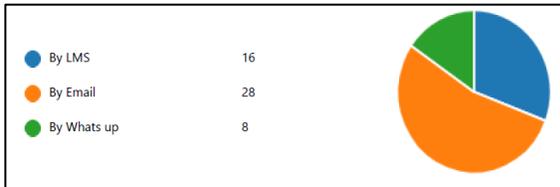
Figure 1.13. Which methods of interacting you used?

By LMS	16
By Email	28
By Whats up	8
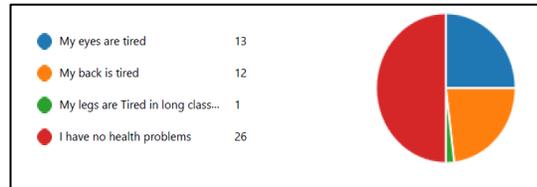
Figure 1.14. During the online class, did you face any health problem?

My eyes are tired	13
My back is tired	12
My legs are Tired in long class...	1
I have no health problems	26
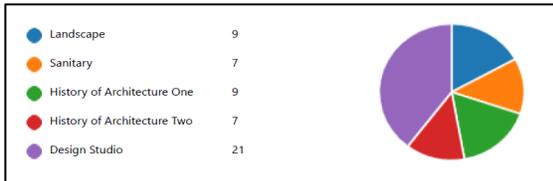
Figure 1. 15. Which course was more exciting to you?

Landscape	9
Sanitary	7
History of Architecture One	9
History of Architecture Two	7
Design Studio	21

Figure 1.16. Which methods of assessment is more effective

Online exam in Midterm and F...	25
Discuss the project in Design ...	5
Discuss small project in Lands...	1

Table 1.2. conclusion of the results

	Strongly Disagree	Disagree	Average	Agree	Strongly Agree
Which Program you use online					
Microsoft Team					**100%**
Zoom	x				
Due	x				
Do you think that your experience with online classes are is effective	**8%**	**10%**	**27%**	**33%**	**23%**

Which type of exercises are more effective				
PowerPoint				53 %
Small projects		17%	4%	
Design projects				
Drawing sketches	9%			
Writing reports	17%			

Which program you used in your assignments				
Word program				**23 5 %**
Excel program			4%	
AutoCAD		56%		
3D Max	4%			

How you Describe your experience with Design Studio in online classes	10%	10%	7%	27%	20 %
How you describe your experience with theoretical classes like landscape, history,	6%	4%	25%	38%	27 %

Sanitary, etc.

During the online class do you facing any problems like

Weakness in the internet	37 %
Have no laptop	6%
The class is too long	12%
Couldn't follow up the teacher	12%
I have no problems	35%

Which method of interacting with your teacher you use

By LMS	31 %
By Email	54%
By What's up	15%

During the online class did you face health problems in

My eyes are tired	25 %
My back is tired	23%
legs are Tired in long classes	2%

I have no health problems	**50%**				
Which is the more exciting course for you					
Landscape					**17 %**
Sanitary				**13%**	
History of Architecture One					
History of Architecture Two			**17%**		
Design Studio	**21%**				
Which method of Assessment is more Effective?					
Online exam in Midterm and Final					**81 %**
Discuss the projects during Design Studio				**16%**	
Discuss the projects in Sanitary			**3%**		
Write your opinion about the whole experience of the online classes	A bad experience - I actually don't like it - Bad idea for architecture class	-we have been wronged with the studio because of distance education	some are good and some are very bad	-It depends on the quality of the student's devices and the strength - I think it's a good experience	I loved the experience of my online classes - t was good not as bad as I expected. despite that in

- Design Studio is not effective for online classes	when we study classes like a landscape	university, it's more efficient with design studio courses. overall - The teachers helped make it easy on us and made sure we all understood it was a nice experience - Unique experience

Table 1.2 shows the results show that most of the students have a good experience of the E-Learning and the virtual classes, in the theoretical and practical courses. Some students are facing problems such as eye problems, back problems because of the long classes time. About 6 students they don't have laptops and most of the student are facing internet problems, it's a general problem and extend few seconds. Most of the students like exams as a perfect way for the assessment method. In addition, most of the students used LMS, university email and wats-up to contact their teacher. 38% of the student they are disagree about their experience in design studio. Most of the students strongly agree to use PowerPoint presentation in their discussion and assignments.

1.5. Discussion the Results

All students are studying in the College of Architecture and Digital Design. All the students used the Microsoft Teams Program by the orientation of the university after the comprehensive workshop to the students and teachers by IT Unit. 23% of the students strongly agree that their experience with the online e-learning is quite good, 33% of the students agree, while 18% of the students disagree.

53% of the students strongly agree to use PowerPoint in their assignments, 4% of the students prefer small projects

17% of the students prefer design projects, 9% of the students disagree with the drawing sketches. In addition, 17% of the students strongly disagree with writing reports assignments. In program used, 23% of the student's used word program, 4% of the students used Excel program, 54% of AutoCAD program, 4% of the students used 3D Max program. In addition, in the practical courses 20% strongly agree with their experience with design studio virtual classes, 21% agree, 7% neutral, and 20% disagreeing with their experience in virtual design studio classes while, 27% of the students strongly agree with the theoretical course's virtual classes. In the problems facing by the online classes are: 27% reported having internet weakness problems, 6% of the students said they do not have Laptops, 12% of the students said that the virtual class is too long, 12% of the students

could not follow up the teacher, while 37% of the students said they did not have any problems with the virtual classes. In addition, 25% of the students are facing eyes problems during the virtual classes, 23% are facing back problems, 2% are facing legs problems because of sitting long period of time, while 50% have no health problems. On the other hand, 31% of the students communicate with the teacher by LMS, and 51% of the students communicate by email, and 15% used WhatsApp.

17% said that the Landscape course is the most excited course for them, while 13% of the students said that sanitary course is the most exciting course to them. On the other hand, 13% of the students disagree that history of Architecture is the most exciting course of them, and 27% of the students strongly disagree that design studio is the most exciting course for them. Also, 81% of the students strongly agree that online exams are the most effective method of assessment on the online e-learning. 16% of the students agree that the discussion during the design studio is the most effective method of assessment, while 3% of the students are neutral.

The last question is an open question to write student's opinion about the virtual classes. Most of the students said it was a good experience, other students said it was a bad experience to them. Table 3 shows the assignments applicable during the lockdown and the inapplicable assignments.

Table 1.3. Analysis's method of assessment before and during the COVID-19

List of Method of Assessment	Before Covid-19	During COVID-19	Notes
Quizzes	Applicable face to face in university campus	Applicate in the online system using the Microsoft Team and LMS	The most efficient method of evaluation
Midterm and Final Exams	Applicable face to face in university campus	Applicate in the online system using the Microsoft Team and LMS	The most efficient method of evaluation
Assignments: Drawing Sketches	Applicable face to face in university campus	Applicate at home. The assignment is uploaded in the LMS and discussed in the online system using Microsoft Team and LMS	The students agree with the assignment
Compare between two case studies, or between different era	Applicable face to face in university campus	Applicate at home. The assignment is uploaded in LMS and discussed in the online system using Microsoft Team and LMS	The students agree with the assignment

Analyzing a case study	Applicable face to face in university campus	Applicate at home. The assignment is uploaded in LMS and discussed in the online system using Microsoft Team and LMS	The students agree with the assignment
PowerPoint seminar and presentation	Applicable face to face in university campus	Applicate at home. The assignment is uploaded in the LMS and discussed in the online system using Microsoft Team and LMS	PowerPoint presentation was the most exciting exercise for the students
Discussing small projects	Applicable face to face in university campus	Applicate at home. The project is uploaded in LMS and discussed in the online system using Microsoft Team and LMS	Students were facing difficulties in solving the problems in the designing. The teacher used the whiteboard to draw sketches for students to understand the problem
Discussing design studio projects	Applicable face to face in the University campus	Applicate at home. The project is uploaded in LMS and discussed in the online system using Microsoft Team and LMS	Students facing difficulties in solving the problems in designing. The teacher used the whiteboard to draw sketches for students to understand the problem
The Collaborative skill	Applicable between Architecture program and Interior program.	Not applicable between the two programs because of Lock	Collaborative skills can be applied in groups in the same virtual class.
Site visit	Applicable	Not applicable	During COVID-19 the students

			used Google Map to study the site
3D Model	Applicable	Not Applicable	The students are not able to use the 3D Model Lab, so we used 3D-Max instead and made a video

Table 1.4. Sample of Learning outcome achieved during COVID-19, course History of Architecture, from course report showing the assessment results of the course during COVID-19 which is Excellent and very good

NQF Learning Domains and Learning Outcomes	*List methods of assessment for each LO*	*Summary analysis of assessment results for each LO*
1.0 Knowledge:		
1.1 Recognize the state of ancient architecture in the different eras: Prehistoric, Egyptian, Mesopotamian Romans, Greek, Byzantine, ancient Japanese, and ancient Indian until reaching Early Christian Architecture	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**90%** **ILO Achieved**
1.2 Memorize the impact of social and political influences on ancient architecture features such as materials, construction systems, and ornaments openings…, etc	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**80%** **ILO Achieved**

2.0 Cognitive Skills:

2.1	Compare between architectures from different time and region (Egyptian Architecture and Mesopotamian Architecture or Romans Architecture and Greek Architecture)	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**89%** **ILO Achieved**
2.2	Analyze case study from the prehistoric architecture in Egyptian, Mesopotamian, Greek, and Romans Architecture	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**87.5%** **ILO Achieved**

3.0 Interpersonal Skills & Responsibility:

3.1	Demonstrate a proper vocabulary individually and in group work	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**85%** **ILO Achieved**

4.0 Communication, Information Technology, Numerical:

4.1	Presenting research by using IT programs: Photoshop, AutoCAD, Powerpoint	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**100 %** **ILO Achieved**
5.0	**Psychomotor:**		
5.1	Hand drawing sketches of buildings in ancient architecture	Multiple and continuous assessment methods: assignments and bonus, mid-term (80%). Summative assessment methods: final exam (20%)	**71 %** **ILO Achieved**

1.6. Conclusion

The research concluded that workshops and continuous training programs are becoming crucial during COVID-19. Additionally, developing the program learning outcomes and the course syllabus, course report and course specification and course contents should be a continuous process to suit the situation of the lock of COVID-19. The assessment method should be supported by the continuous evaluation of the students by quizzes, assignments, the midterm exam should be from 80% and the final exam from 20% congruent with the directives of the Ministry of Education. The research concluded that the university and the college should include the E-Learning system as a part of the education process, and it should be activated when need it. In addition, the student-manual should be included health orientation during COVID-19 time. The teacher should encourage the students to communicate through the LMS, emails, and other messaging apps such as WhatsApp to solve any problem facing the students. A survey was sent to the students asking them about the problems they are facing the virtual. Our results show that most of the students are facing weakness on the internet. It is recommended to raise these problems to the IT to solve the weakness on the internet. Others said that the class is too long, and they cannot follow-up with the teacher. This problem can be solved by making the duration of the class not more than two hours for the lecture and the discussion. A minority of the students (6%) reported that they do not have a laptop. These students could be helped by a social loan

from the university for a long period of time. The research recommends that the questions of the exams should be short, easy, and depends on the student's knowledge.

Finally, the teachers should post the course syllabus and course specifications on LMS. In addition, they should post all their lectures, videos, eBooks, useful links, announcements assignments orientations, and the online exams. The IT should provide a student manual explaining to the students how to use the LMS to upload their assignments, communicate with their teacher, and follow up the announcement. limitations in current research and future researches should be added in this area the effect of COVID-19 on teaching and learning and records the lessons learned.

Acknowledgement

References

APPQMR. (2020, June 30 Tuesday). *Applying the Quality Matters Rubrics*. Retrieved from PPQMR: https://www.qualitymatters.org/professional-development/workshops/higher-ed-appqmr

Alia AhmedAltaf-ur Rehman, A. I. (2020). *REPORT ON ONLINE TEACHING AND LEARNING AMID COVID-19*. Bakistan: National College of Business Administration & Economics (NCBA&E), Lahore (Pakistan), https://doi.org/10.13140/RG.2.2.25997.36320/1.

Admiraal, W. (May 2020). *Teaching and learning from home - what we have learned from pre-COVID-19 times*. Engineering students' perception of workplace English in Turkey (p. 100). Turkey: Leiden University Graduate School of Teaching, https://www.researchgate.net/publication/341266777_Teaching_and_learning_from_home_-_what_we_have_learned_from_pre-COVID-19_times.

Buisness, C. o. (2020). *Electronic Exams Gudelines for students*. Saudi Arabia: Dar Al Uloom University.

Control, S. C. (2020). *Health Practitioner Infection Control Measures*. Saudi Arabia: Saudi Center of Desease Prevension and Control.

Control-2, S. C. (2020). *Booklet orientation Against COVID-19 in workplace*. Saudi Center of Desease Prevension and Control.

MEED. (2020). *COVID-19 Sparks Contract Issues*. UK: MEED Business.

Patel, S. (2019). *Top 6 eLearning Trends Of 2019*. French: E-Learning Industry, https://elearningindustry.com/.

Renée M. Filius1, R. A. (17 March 2019). *AudioPpeer Feedback to Promote deep Learning in Online Education.* Journal of Comuter Assessment Learning, WILEY, https://doi.org/10.1111/jcal.12363

Robert, J. H. (2019). *Smart Education and e-Learning.* USA: Springer.

Solution, E. D. (15-5-2020). *Post COVID-19 Work place Stratigies.* Vasant Vihar, New Delhi: Environmental Design Solution Pvt Ltd.

SRF_Webinar. (2020, June 2 Tuseday). *Medical Health Professional Education Wibinars durring COVID-19 and After.* Retrieved from You Tube Chanel: https://www.youtube.com/watch?v=3WoPkryZDo0

SRF-Webinar. (2020, May 29, Friday). *My Experience with Effective and Innovative Engineering Learning.* Retrieved from Youtube: https://www.youtube.com/watch?v=uWzmdU2KGiA&fbclid=IwAR0zoQSuJukSlR qbtM_HelDPQN5exqiXoKA0GcKNTrPDaigOVsoW_UDYO0A

SRF-Webinars. (2020, June 8, Monday). *E- Engagement of the E-Learning during COVID-19.* Retrieved from You Tube: https://www.youtube.com/watch?v=eHtjKfeaAwI

Support, I. T. (2020). *LMS Exam Setting.* Saudi Arabia: Dar Al Uloom University.

UNESCO. (2020, June 21 Sunday). *COVID-19 Resonse*. Retrieved from UNESCO: https://en.unesco.org/covid19

UDL. (2020, July 5 Sunday). *Universal Design for Learning UDL.* Retrieved from UDL: http://udlguidelines.cast.org/

Webinar, S. (2020, May 11 Thursday). *Changing in The E-Learning in Sudan Between the Present and The Future.* Retrieved from Youtube channel: https://www.youtube.com/watch?v=U8MB8Mg5NyU

Webinar, S. R. (2020, June 20 Sat.). *The Effect of COVID-19 in Teaching and Learning in Architecture Engineering Colleges.* Retrieved from YouTube: https://www.youtube.com/watch?v=ehp0Ufis-QI&t=6s

WHO. (2020, MARCH 16 Monday). *Word Health Organization.* Retrieved from Coronavirus disease (COVID-19) pandemic: Coronavirus disease (COVID-19) pandemic

WCAG. (2020, July 5 Sunday). *Web Content Accessibility Guidelines*. Retrieved from (WCAG) 2.0: https://www.w3.org/TR/2008/REC-WCAG20-20081211/

CHAPTER TWO

Assessment for the Evaluation of E-Learning and Teaching by the Quality Matter Standards Post COVID-19

Assessment for the Evaluation of E-Learning and Teaching by the Quality Matter Standards Post COVID-19

Khogali, H., 2021

Abstract

On 18 March, the WHO announced that COVID-19 was a global pandemic, and the Ministry of Health instituted a COVID-19 lockdown. After the period of restrictions ended, blended learning was initiated at the universities.

The research aims to evaluate the responses of students, teachers, and quality units in the teaching and learning process by Quality Matter standards. The survey was constructed using a Google form. The research recorded positive data in most of the Quality Matter Standards (QM) in Architecture Engineering Program applied by 95%. Some weakness points were identified 5% and are discussed in this paper. The results by (QM) St1 (2.7/3), St2 (2.6/3), St3 (2.6/3), St4 (2.6/3), St5 (2.6/3), St6 (2.5/3), St7 (2.6/3), St8 (2.7/3). General conclusions are added for teachers to be applied to e-learning education

Keywords: assessment of quality matter, higher education, e-learning, post-COVID-19, data use, student management system, quality matter standards checklist

2.1. Introduction

The Quality Matter is an international online system for learning that helps institutions achieve their goals with well-conceived, well-designed, well-presented courses and programs and enables them to be certified by quality assurance organizations (Matter, 2020). Since the lockdown 2020, most universities applied the e-learning on the second semester 2020. During the new academic year, the university is going into blending teaching and learning, the practical courses in campus and the theoretical courses online.

The problem of the research that the e-learning was applied on the second semester 2020 was not planned, and the teachers were not trained. That's why the QM has been applied by the university to improve the quality of e-learning and teaching during the academic year 2020-2021, in Architecture Engineering courses the results were recorded for September 2020-1 semester, the results is distributed to the faculty member for improvement plan.

The objectives of this research; to evaluate Architecture courses using a Quality Matter checklist in an E-Learning system; to improve the course's learning outcomes results; to record the weakness points for greater improvement; to compare the results of different stockholders (Quality Unit-Students) for greater improvement.

1.1 Research Hypotheses

1) Student Learning System (LMS) is applying the Quality Matter Standards
2) The Architecture courses pass the evaluation
3) There is an improvement plan to develop the e-courses in Architecture program

1.2 Literature Review

IEA (2007) published a report about the role of international engineering alliances. Their focus objectives included consistent improvement of standards and mobility, defining standards of education and professional competence, assessment of education accreditation

and evaluation of competence, and participation in activities that are driven by the engineering profession.

The report expanded the graduate attributes by the Washington Accord. They categorized what graduates should know, the skills they should demonstrate, and the attitudes they should possess, such as problem-solving, communication skills, writing different reports, designing documentation, making effective presentations, and knowledge of engineering practice (technology) in the practice areas and in the engineering discipline. Shattuck (2019) applied the quality matter standards on the KG-12 and recorded the results on the learning outcome of the research. The results show that standards 4, 5, 6, and 7 had outstanding results because of student engagement in activities such as research and interaction with peers or teachers.

ABET (2019) published a report about the criteria of accreditation for engineering programs, including student program education, student outcomes, continuous improvement, curriculum, facilities, and faculty. In criteria 1: The program must have enforced policies for accepting both new and transfer students, appropriate academic credit must be awarded for courses taken at other institutions, appropriate academic credit must be awarded for work. Also, the program must have enforced procedures to ensure that students who graduate meet all graduation requirements, and these metrics should be documented. In criterion 7, the facilities should be applied in classes, offices, and laboratories, and associated equipment.

ETEC (2020) published national engineering learning outcomes. The National Engineering Learning Outcomes shall be aligned with the NQF descriptions of the learning outcomes at the bachelor's degree level. The three focus domains in learning outcomes include:

- Knowledge
- Skills
- Values

Table 2.1. Comparison between international, national and program learning outcomes

International Washington Accord Graduate Attribute Profile Elements	National Engineering Learning Outcomes							Architecture Program Learning Outcome
	ELO1	ELO2	ELO3	ELO4	ELO5	ELO6	ELO7	
WA1	✓							✓
WA2	✓							✓
WA3								
WA4	✓	✓			✓			✓
WA5	✓	✓	✓	✓				✓
WA6		✓				✓		✓
WA7		✓				✓		✓
WA8		✓				✓		✓
WA9				✓				✓
WA10			✓	✓				✓
WA11				✓				✓

WA12	✓	✓

Source: (ETEC, 2020).

(QM, 2019) provided a report about virtual support for teaching the quality matters to create and provide superior courses for students and schools that are the standard for all learning in the state of Arkansas and nationwide. The Quality Matter QM course review process allows the students to receive a much clearer and more consistent course, which is vital to reaching their goal. QM (quality matter, 2020) published a white paper about administrative digital accessibility at the institutional level. Institutes should provide regular support for digital accessibility, such as web accessibility, online learning, budgets, improved technical skills for students and teachers and administrative staff and policies for technical and digital use. The survey should be distributed to users to received responses about technical support.

QM (Quality Matter, 2021) published the quality matter checklist, see page 4). Figure 1: Quality Matter standards. Source: Quality Matter.org. The latest research papers discussed E-Learning during COVID-19; Mammadova, I. (2020) discussed using the new technology in teaching the design such as divided the class into groups and get feedback from them, operate the platform, and learn the students how to deal with a real-life. Daniel C. (2020). discussed in his book innovation ideas in E-teaching and E-Learning during COVID-19; the book explained different innovation ideas to be applied in the online teaching such as develop the platform and develop the courses during 2020 is becoming crucial. Besides Mseleku, Z. (2020) discussed the start of the transformation into online teaching and learning during COVID-19 and highlight that higher education may have transformed and moved to online. Ghobrini (2020) discussed in his research paper using YouTube and Facebook as teaching technology in E-Learning and E-Teaching in Grammar during COVID-19. Sadaf, A. (2019) the research paper applied the quality matter on the impact of the students in University of North Carolina Charlotte the results help the researcher to develop the learning outcome. Alizadeh, M. (2019) the researcher reflects the experience in Japan with the blending learning and applied the QM for evaluating the learning outcome the results shoe failure 70/99 the orientation from the reviewer advice to re-evaluate and improvement should be done. Jassim, L. L. (2020) the researcher discussed Information and Communication Technologies (ICTs) in Iraq in the last year in the E-Learning and teaching. Sireesha1, N. (2020) the researcher highlights the use of digital technology in studying the MBA in India the results recommend using LMS to build trust of the students. Also, Sharma, A., (2017) the researcher highlighted using of different technologies such as virtual classes, virtual labs in e-learning and teaching. Khogali, Hind (2020) the researcher discussed the effect of COVID 19 on teaching and learning in architecture colleges and the blending learning during the lockdown in 2020.highlighted the important of training the teachers and improve the Wi-Fi in the university.

The last literature in the field of the study: Goda (2020) highlighted the importance of Technology and online learning platforms have become an essential part of the educational process, learner support, workshops, and interactive learning. Oyediran (2020) highlighted some problems facing least developed countries such as in Nigeria vis-_a-vis their socio-economic factors and limitations encountered and poor infrastructure and networking. Fauzi (2020) highlighted some problems facing the online teaching in West Java such as availability of facilities, network and internet usage, planning, implementation, and evaluation of learning, and collaboration with Parents and highlighted the importance of the policies and research to compare the experience of online teaching with others to find solutions. Sultana (2020) highlighted the point that the e-learning should be available for all students in the country, require high skill, be independent, large groups, smart learning. Vaid (2020) highlighted the importance of using the artificial intellegent in e-Learning and accuracy of deep learning. Education, Sweden National Agency for Higher. 2008. This model has been developed using analyzes of policy documents, networks and development

projects initiated within the framework of European cooperation. Karin J. (2019) highlighted the point the effect of assessment, interpretation, the credibility of assessment, on e-learning the students response is positive to these variables. Mark, Th. (2020) discussed the effect of COVID-19 on education in Saudi Arabia and highlight that most of the schools change to online teaching and learning, the need of the platform, strong internet, mobile, computer devices all are available in Saudi Arabia by 90 % and this succeeds the e-learning education in Saudi Arabia and, Also, Mark, Th. (2021) highlighted e-learning and teaching in Saudi Arabia. Mark, Th. discussed the effect of COVID-19 on public health, economy, and migration in Saudi Arabia, these areas could be an area of future research studies.

The researcher believe that each country has own experience in the e-learning according to the available technologies, and can take the benefits of other countries experience.

1.3 The Procedures Applied by the College to Achieve QM Standards

1.3.1 Develop the Course Syllabus

During 2020-2 semester college of architecture applied the total grade distribution: 60% for the continuous assessment and 40% for the final exam.

1.3.2 Develop the Course Learning Outcomes

(Khogali, H. 2020) stated that The College of Architecture Engineering developed the course learning outcomes according to in the National Center of Academic Accreditation and Evaluation (NCAAA)

1.3.3 Develop the Students' Learning and Management System (LMS)

The Quality Unit provided a comprehensive workshop to the University Staff. The workshop explained the eight standards of E-Learning and stated that faculty members should develop his/her LMS page, everything should be clear for the students, and the course syllabus, course specifications, lectures, online exams, and student manual should be uploaded. Figure 2: Screenshot from the university LMS

1.3.4 Develop the Course Report

The university follows the NCAAA template. The last update has been applied, consisting of the NAGF and 3 main domains of learning outcomes, including knowledge, skills, and values.

1.3.5 Develop the Course Learning Outcomes

History of Architecture course (ARC213)

Khogali, H. (2020) discussed the course history of architecture learning out come

Environmental Control (ARC404)

Khogali, H. (2020) discussed the learning outcomes in Environmental control course

Design Studio One (ARC211)

Knowledge is achieved by letting the student draw and design warm-up exercises in bedrooms, master bedrooms, and flats for students living in the UK using Neufert for Architecture Data.

Skills are achieved through case study analysis, heritage case study analysis, and modern case studies. The design concept develops the student's critical thinking ability to design a Modern Saudi Villa using modern design projects in villas as inspiration.

The design project is developed. Besides, Discussions take place in multiple juries.

Blended learning is used (50% of learning is on the university campus, 50% is online using Microsoft Teams).

Value: is achieved by teaching the student the responsibility of uploading their assignments in the LMS on time. Additionally, teamwork is used for case studies and site analyses.

Theory of Architecture one (ARC302)

Knowledge is evaluated in the midterm, short exam, and final exam.

Cognitive skills are achieved by five weekly assignments, analysing case studies in the history of the Middle Ages and prehistoric architecture, and comparing between different eras.

Interpersonal skills are achieved by uploading all the assignments in LMS and attending the virtual class at the appropriate time.

Communication skills are achieved by encouraging the students to discuss their assignments through virtual classes during lectures. The discussion is directed by the teacher and sometimes between the students in groups.

Psychomotor skills. The sketch is submitted in the LMS. The teaching method employs PowerPoint presentations.

1.3.6 Comprehensive Workshops

Workshops are held by the university about e-learning and the quality matter standards. The workshop explains the eight standards.

2.2. Method

This research is quantitative research based on a survey distributed to students in architecture colleges. The survey tool was used to record their responses to teaching and learning in the virtual classes. It was constructed using Google Forms and sent to 73 students after they completed their final exams between 30/11/2020 and 30/12/2020. The survey contains 43 questions, including 8 standards of Quality Matter in Figure 1, general information, the responses from the students about design studios and theocratical courses, the technical problems facing the students during virtual classes, and the responses of students towards the method of assessment.

A comparison between the university experience and Alyamamaha and Efatt universities in the 17-NCAAA learning out comes was done by the DAU quality unit in the 2020-2 semester, the performance range between 3/5 to 4/5

This research developed the Quality matter checklist to evaluate in five points instead of three points of evaluation

Quality for E-Teaching and Learning Courses process

1.Polices

Plan

Applied

Announce The Results by Email

• The Instructors should be Informed by the results

2.Plan

• Improvement plan should be done to the weak e-courses evaluation result

3.Imediatly Implementation of the plan for Improvement

• Workshops and professional traing program

4. Evaluation of the E-Courses by Quality Matter

5. Compare the Results with Others for Improvement

Figure 2.1. The e-learning courses Quality matter evaluation process
Source: designed by the researcher

Figure 2.2. Quality Matter standards. Source: Quality Matter.org

2.3. Results

The results record from the distributed survey to all the students in the architecture program 2020–2021-1 semester. The evaluation method for each category.

The number of points achieved /Total Number of points, Strength points, to record the weakness points. All the standard results records in the followings:

3.1 Standard 1: Course Overview

It was achieved by 90% (2.8/3) in the four courses Environmental Control (ARC404), History of Architecture (ARC213), Theory of Architecture (ARC302), and Design Studio (ARC211). The learners answered standard points 1.1, 1.3, 1.5, and 1.6 positively, and the course overview achieved QM standard 1. The learners highlighted some weak points, such as substandard point (1.4.) the policies are not available Substandard point (1.2.) Computer skills and digital information literacy skills expected of the learner are clearly stated. (1.7)

the teacher should give more explanation (1.8) the students should know of the present. Figure 3 shows the results of standard 1.
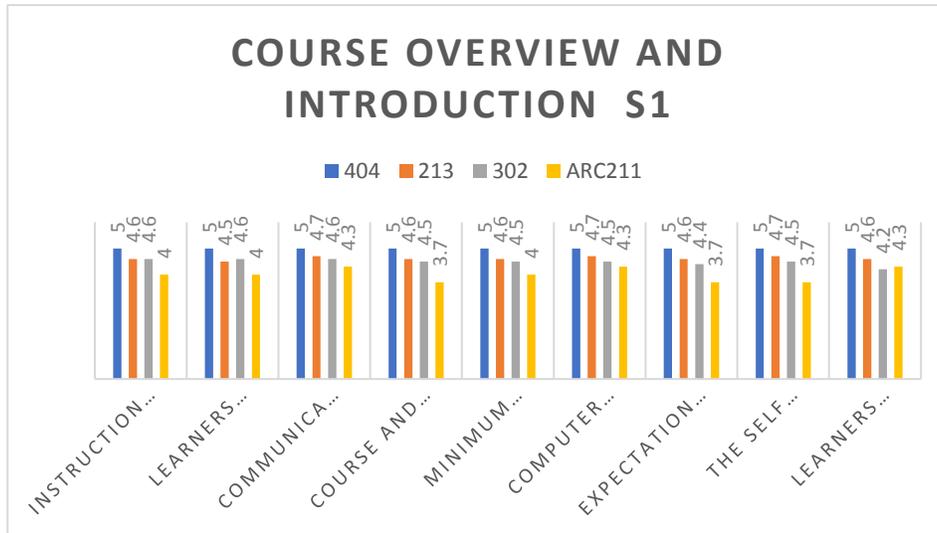
Figure 2.3. Evaluation, of the courses ARC404, 213, 302, 211 Standard 1 in Quality Matter

3.2 Standard 2: Learning Objectives

(Competencies) was achieved by 87% (2.6) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered standard points 2.1, 2.2, 2.3, and 2.4 positively, which means that the courses achieved QM standard 2 in QM. The learners highlighted some weak points: Substandard point (2.5), the learning objectives or competencies are suited to the level of the course. Figure 4 shows the evaluation of Standard 2
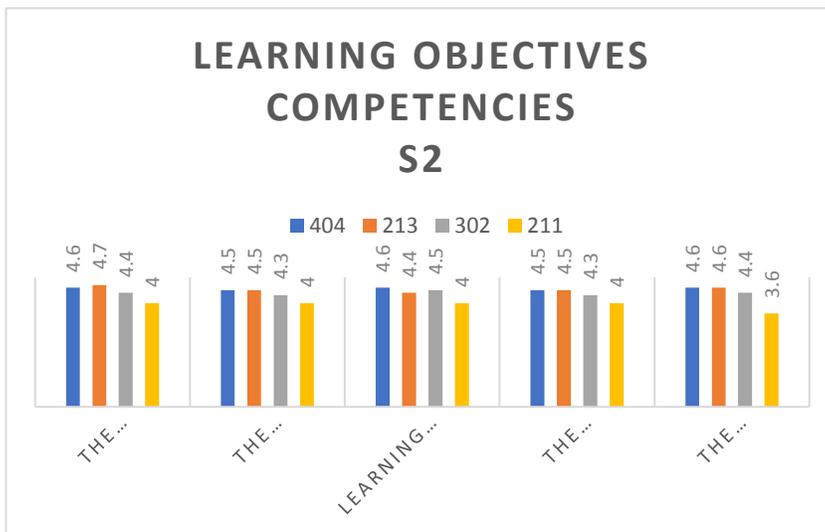
Figure 2.4. Evaluation, of course, ARC404, ARC213, ARC302, ARC211 Standard 2 in Quality Matter

3.3 Standard 3: Assessment and Measurement

It was achieved by 86% (2.6/3) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered standard points 3.1 and 3.4 positively, which means that these two points achieved QM standard 3. The learners highlighted some weak points, such as:

Substandard point (3.2), the course grading policy is stated clearly at the beginning of the course (33%).

Substandard point (3.3), specific and descriptive criteria are provided for the evaluation of learners' work, and their connection to the course grading policy is clearly explained (33%). Figure 5 shows the evaluation of standard 3.
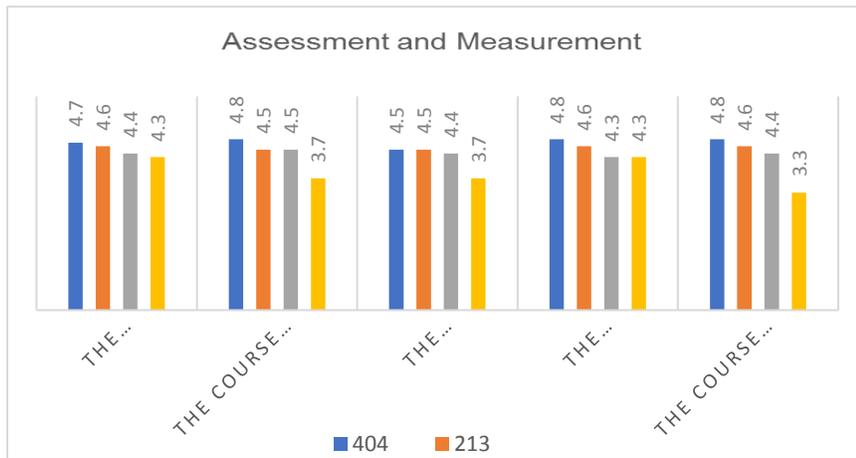
Figure 2.5. Evaluation of courses ARC404, ARC302, ARC213, and ARC211 for standard 3 in Quality Matter

3.4 Standard 4: Instructional Materials

It was achieved by 88% (2.6/3) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered points 4.1, 4.2, 4.3 positively, which means that they achieved QM standard 4. The learners highlighted some weak points, such as Substandard point (4.4) The instructional materials represent up-to-date theory and practice in the discipline (33%). Substandard point (4.5) A variety of instructional materials are used in the course (33%). Figure 6 shows the results of standard 4.

INSTRUCTIONAL MATERIALS
S4
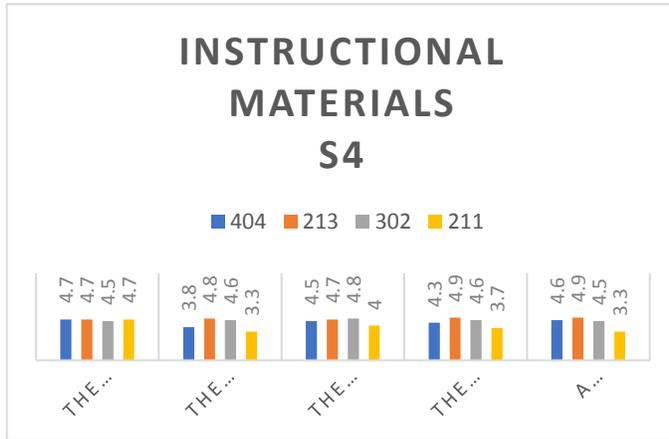
Figure 2.6. Evaluation of courses ARC404, ARC213, ARC302, and ARC211 for standard 4 in Quality Matter

3.5 Standard 5: Learning Activities and Learner Interaction

was achieved by 83% (2.5/3) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered points 5.2, 5.3, and 5.5 positively, which means they achieved QM standard 5. The learners highlighted some weak points, such as substandard point (5.1) learning activities promote the achievement of the stated learning objectives or competencies (33%). In addition, substandard point 5.4 the requirements for learner interaction are clearly stated (33%). Figure 7 shows the results of standard 5.
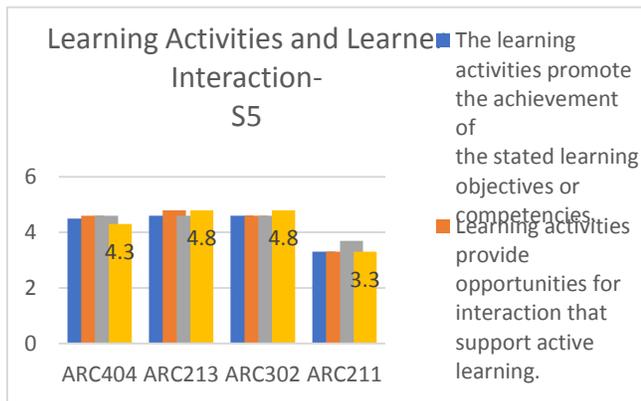
Figure 2.7. Evaluation of courses ARC404, ARC213, ARC302, and ARC211 for standard 5 in Quality Matter

3.6 Standard 6: Course Technology.

It was achieved by 85% (2.6/3) in the four courses (ARC404, (ARC213, (ARC302) and (ARC211). The learners answered point 6.4, which achieved the standard level in QM. The other three points will be discussed in the Discussion. The learner highlighted some weak points, such as Substandard point (6.1) the university gave tools help in teaching and learning. Also, substandard point (6.2) Course tools promote learner engagement and active learning. 6.3 the university is using variety of technologies in teaching. Figure 8 shows the results of standard 6.
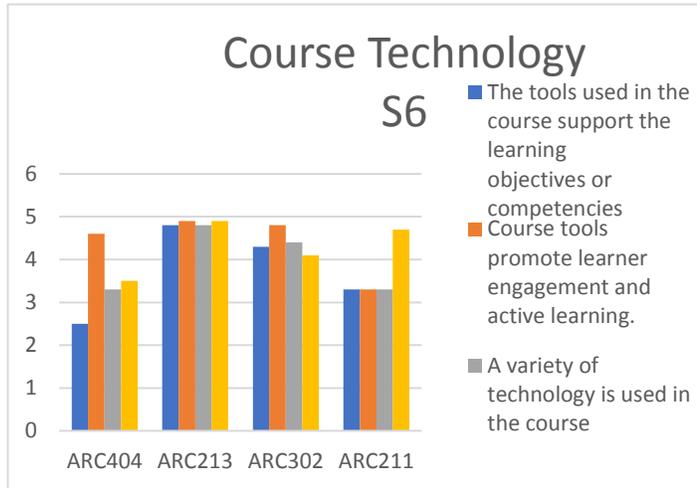
Figure 2.8. Evaluation of courses ARC404, ARC302, ARC213, and ARC211 for standard 6 in Quality Matter

3.7 Standard 7: Learner Support

Learning support was achieved by 87% (2.6/3) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered points 7.2 and 7.4 positively, which means that they achieved QM standard 7. The learners highlighted some weak points, such as (7.1) the course instructions articulate or link a clear description of the technical support offered and how to obtain it (LMS manual). 7.3 course instructions articulate or link the institution's academic support services. Figure 9 shows the results of standard 7.
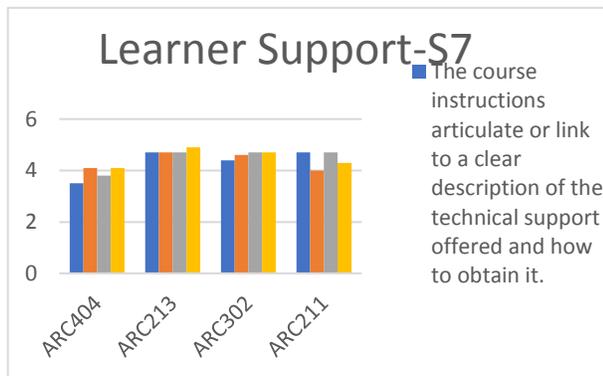
Figure 2.9. Evaluation of courses ARC404, ARC302, ARC213, and ARC211 for standard 7 in Quality Matter

2.3.8 Standard 8: Accessibility and Usability

Accessibility was achieved by 89% (2.76/3) in the four courses (ARC404, ARC213, ARC302, and ARC211). The learners answered points 8.5 and 8.6 positively, which achieved the QM standard 8 learning outcome. The four other points will be discussed in the Discussion.

The learners highlighted some weak points, such as 8.1 Course navigation facilitates ease of use (new LMS). 6.2 The course design facilitates readability. 8.3 The course provides accessible text and images in files, documents, LMS pages, and web pages to meet the

needs of diverse learners (images). 8.4 the university is providing the WIFI for access to the (websites) 17%. Figure 2.10 shows the results of standard 8.
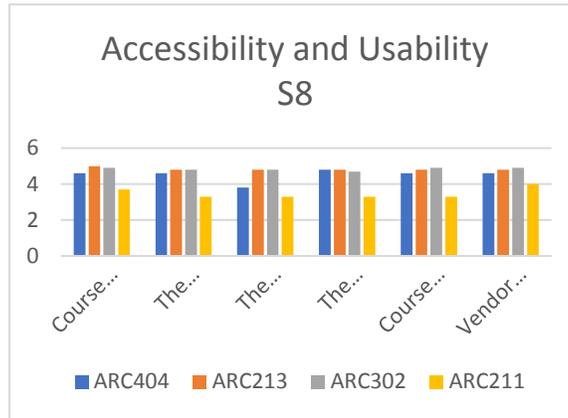
Figure 10. Evaluation of course ARC404, 302, 213, 211 by Quality Matter, S8

The average result is calculated for all the standards in the following table one response by the students the other response by the university quality unit. Table 2 shows the result by students, and Table 3 shows the result by the university.

Figure 11 shows the vibration in evaluation between the student and DAU Quality Unit, the students evaluate ARC 211 2.6/3, while the QU evaluate ARC211 2.8/3 in applying the QM standards this means that the response of student is not correct and it's based on personal feeling towards the course or the teacher, on the other hand, the QU evaluation is a professional evaluation based in the learning outcome and applying the QM standards. Figure 13 shows the evaluation by QU to all Architecture Eng. Courses which are range between 85% to 90%, this means that most of the courses are achieved the QM standards, except 3 courses over 48 courses those will be focus on training program and improvement plan during this semester 2020-2021-2 .

Table 2.2. The results by the students

	QM ST1	QM ST2	QM ST3	QM ST4	QM ST5	QM ST6	QM ST7	QM ST8	Total out of 3
ARC404	3	2.73	2.73	2.61	2.7	2.1	2.3	2.7	2.6/3
ARC213	2.76	2.73	2.7	2.88	2.8	2.9	2.8	2.9	2.8/3
ARC302	2.7	2.64	2.64	2.76	2.76	2.64	2.8	2.9	2.7/3
ARC211	2.4	2.4	2.28	2.28	2.1	2.25	2.8	2.1	2.6/3

Table 2.3. The result by the university Quality Unit

	QM ST1	QM ST2	QM ST3	QM ST4	QM ST5	QM ST6	QM ST7	QM ST7	Total out of 3
ARC404	-	-	-	-	-	-	-	-	2.6/3
ARC213	-	-	-	-	-	-	-	-	2.6/3
ARC302	-	-	-	-	-	-	-	-	2.7/3
ARC211	-	-	-	-	-	-	-		2.8/3
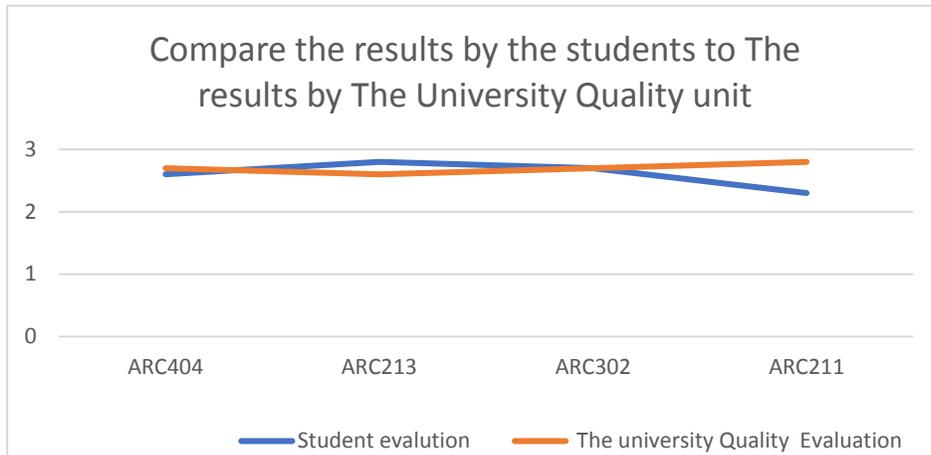
Figure 2.11. The results between the University QU evaluation and the student's evaluation

	1	2	3	4	5	6
Rate of satisfaction, the first category: The technologies used in e-learning	4.2	4	4.3	4.2	3.8	
Rate of satisfaction, the second category: Designing electronic courses	3.9	4	4	3.9	4	3.8
Rate of satisfaction, the third category :Interaction within e-courses	3.9	3.9	3.8	3.9		
Rate of satisfaction, the fourth category: Qualification and Support	3.8	3.9	3.9	3.9	3.8	
Rate of satisfaction, the fifth category: Assessment and Measurement	3.8	3.8	3.8	3.9		

Figure 2.12. The results of the e-learning by The University QU and the Response of the Students for all courses in Architecture Engineering program, 20-21-1

5. Discussion

Dar Al Uloom University recently started to apply the Quality Matter standards in all colleges, including the College of Architecture Engineering and Digital Design. The Quality Unit evaluates all the courses in the Student Learning System.

In this semester, 20-21-1, the researchers started to develop the course pages in the LMS following the QM checklist to achieve a high standard in e-learning.

The surveys were distributed to the students at the end of the semester during the period 30/11//2020 to 30/12/2020. The survey evaluated the following courses: Environmental Control, Theory of Architecture, History of Architecture, and Design Studio. A total of 73 students participated in courses ARC404, ARC302, ARC213, and ARC211. The survey included eight QM standards with questions in the standards. The learners highlighted some weak points that will be discussed. (Oyediran, 2020) and (Fauzi 2020) highlighted some problems facing least developed countries such as in Nigeria vis-_a-vis their socio-economic factors and limitations encountered and poor infrastructure and networking. In Saudi Arabia, the government offers Wi-Fi in 90% (Mark, Th. 2021). In Saudi Arabia, all universities in public and private sectors areas offer the platform, there are some constraints in weakness on the internet sometimes, but it soon comes back and continued the online lectures.

5.1 Course Overview

The Architecture program follows Dar Al Uloom university policies and formulates its own policies for the students for registration, acceptance, attendance, evaluation criteria, teaching strategies, students' awards, and ethics. However, the teachers were not including the policies in the LMS.

Computer skills and digital information literacy skills expected from the learner are clearly stated. All the students learned computer skills in the primary year, which is basically learning for all disciplines. The Architecture program students studied AutoCAD and 3D Max in the second year.

Expectations for prerequisite knowledge in the discipline and/or any required competencies are clearly stated. Prerequisite knowledge is applied in the study plan. No student can register for the course unless he has passed the prerequisite course. This policy is clear to the students and is explained to them by their academic advisor and in the student handbook.

The course survey is clearly stated at the top of the course page in the LMS, and an introduction about the teacher's CV was given in the first lecture in the course.

5.2 Learning Objectives (Competencies)

The learning objectives or competencies are suited to the level of the course. Each course has a Course Learning Outcome (CLO). It is clearly stated in the course syllabus and course specification, and both were explained to the students in the first lecture (Introduction about the course). In the History of Architecture and Environmental Control courses, the required learning outcomes were verbal analysis and comparing, discussing, explaining, and drawing sketches. In the Design Studio course, the required skills include verbal critical thinking, solving the design problem, developing a design concept, designing 3D or model making, discussing in Joris, designing presentations, analyzing the site condition, and case studies in group work. All courses should apply the three main competencies (knowledge, skills, value). All the assignments should reflect the course competencies

5.3 Assessment and Measurement

51

The researcher, Karin J. (2019), highlights the point the effect of assessment, interpretation, the credibility of assessment, on e-learning the student's response is positive to these variables.

The findings in this study show that the teacher provides a file for each assignment explaining and giving specific description criteria for the evaluation of the learner's work. The file is posted in the LMS near the lecture's files. Also, the course grading policy is written in the course syllabus, which is posted into the LMS and explained to the students in the first lecture.

The findings show that thirty-three percent of the learners stated that the course grading policy was not clear. The teacher should have a file for each course that is posted in the LMS clearly stating the grading policy; also, it is written in the course syllabus. Thirty-three percent of the learners stated that the specific and descriptive criteria provided for the evaluation of learners' work and their connection to the course grading policy did not clearly explain the procedures followed by the teacher.

5.4 Instructional Materials

Thirty-three percent of the learners highlighted some weak points such as:

The instructional materials represent up-to-date theory. The law gives the teacher the ability to change 25% of the course materials, usually the teacher adding two new topics according to the market needs. Also, a variety of instructional materials are used in the course, including lectures, eBooks, lecture videos, useful website links, and YouTube. Figure 13 shows different teaching materials are used, such as lectures, lecture videos, teacher blogs, YouTube channels, and teacher websites.
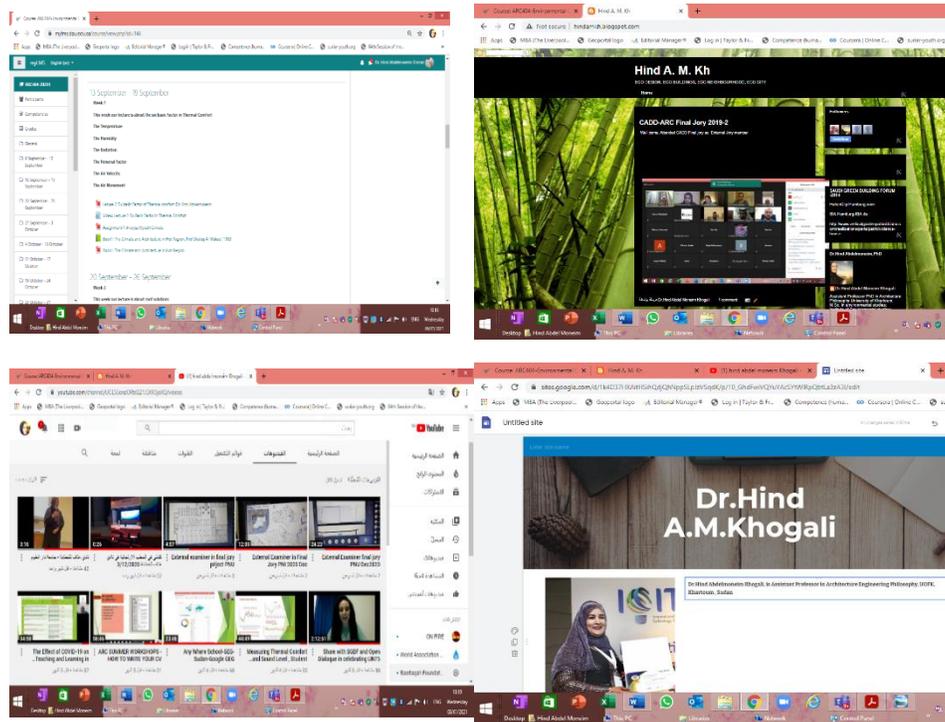
Figure 2.13. Different teaching materials used, such as Lectures, lecture videos, teacher blogger, teacher YouTube channel, and teacher website

5.6 Learning Activities and Learner Interaction

Thirty-three percent of the learners highlighted some weak points from the following:

Learning activities that promote the achievement of the stated learning objectives or competencies are not identified. Also, the teacher in the first lecture explained the course syllabus and course specification, both of which include the alignment of the assignments with the course learning outcome.

The teacher should prepare some questions for each lecture to ensure that all the students are engaged in the course activities. Some assignments are designed to be group work to encourage the students to interact with the course learning outcome. Various assignments and activities were designed to achieve course learning outcomes, such as analyzing case studies, analyzing project sites, comparing different pioneering principles or different history eras by comparative points, drawing sketches, designing 3D models, discussing group work, and discussing PowerPoint presentations. The value is achieved by teaching the student the responsibility of uploading the assignments at a specific time, submitting the course file, and group work and team leadership. Knowledge is achieved and tested in the midterm, final exams, and questionnaires.

5.7 Course Technology

Goda (2020) highlighted the importance of technology and online learning platforms have become an essential part of the educational process, learner support, workshops, and interactive learning. Another point was highlighted by Vaid (2020) to use the artificial intelligent in teaching and learning as new technology Also Mammadova, I. (2020) highlights the point of using different technologies. In this research Twenty-two percent of the learners highlighted some positive points from the following:

The teacher used different tools to help the learner apply their assignments and achieve the learning outcome.

Apply of the Microsoft Teams program gives the teacher and the students the ability to present the lectures online and to listen, speak and discuss during the lecture, use of the whiteboard, and smartboard are used in Microsoft Teams. The Student Management System (LMS). The Lecture videos: usually, the teacher records the lecture and posts it in the LMS. Also, the teacher's YouTube channel. The teacher recorded additional information for the students. Also, support method could be the teacher's website, screens from the students are shared to explain their project; the 3D model of the project that is used in the design projects is explained online; virtual lectures are used. The students attended virtual lectures with Prince Sultan University; virtual conferences are used to help the students attend the virtual forum with Ach-Net. Teacher blogger can support course new technologies. Figure 14. shows different course technologies (a-d). Some learning tools are not used such as virtual sites, virtual visits, virtual reality, and virtual labs.
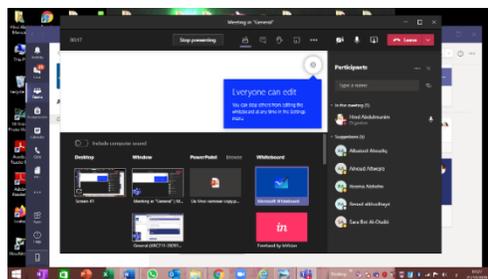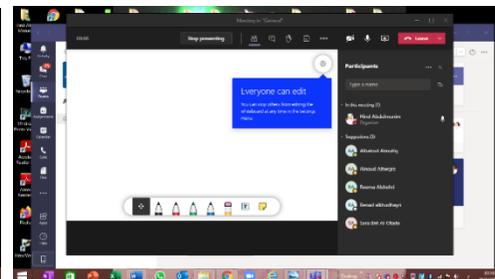
(a) Microsoft Teams   (b) Whiteboard
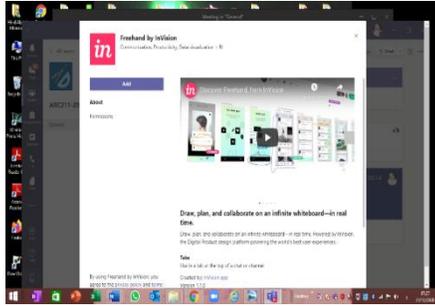
(c) The envision

(d) Virtual Reality

Figure 2.14. Different course technologies (**a-d**). Some learning tools are not used such as virtual sites, virtual visits, virtual reality, and virtual labs

5.8 Learner Support

Thirty-three percent of the learners highlighted some weak points from the following:

IT unit at Dar Al Uloom University offered an orientation workshop to the students and teachers at the beginning of the semester about SIS and LMS. An orientation email was sent by the IT unit to the students and teachers about LMS enrolment. An orientation email was sent by IT about how to secure a user password. An orientation email was sent by IT about online exams. An orientation email was sent by IT about how to secure your email from hackers. DAU measured the user responses towards the services at the end of each semester to improve the IT services. Accessibility to DAU WIFI is available for students and teachers. Projectors and data platforms are available. The teacher provided the IT support phone, email, and office location in one file and posted it for each course. A digital library is available for the students and the teachers. Figure 15. shows the IT support by email (a), in the University platform (b), the Digital library (c), and the LMS, SIS (d)
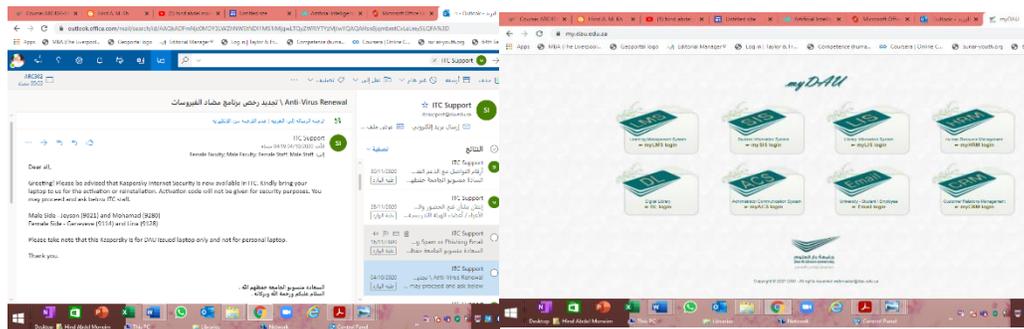
(a) The email

(b) The platform
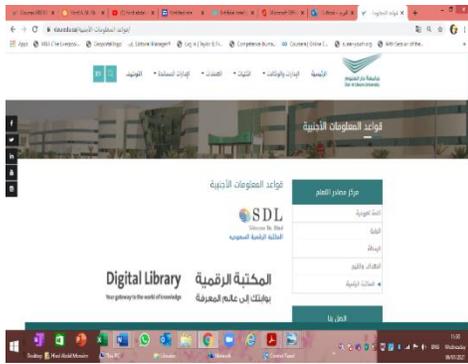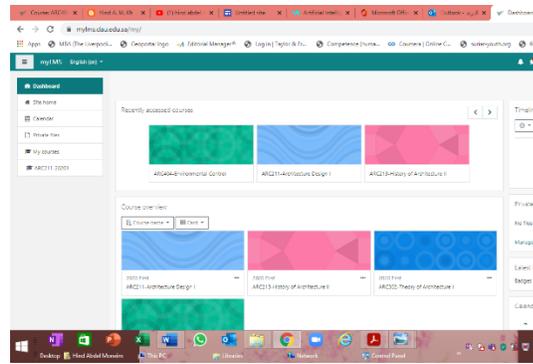
(c) The Digital Library   (d) The LMS

Figure 2.15. The IT support by email (a), in the University platform (b), the Digital library (c), and the LMS, SIS (d)

5.9 Accessibility and Usability

The research found that seventeen percent of the learners highlighted some weak points from the following:

Course navigation facilitates ease of use (new LMS). The course design facilitates readability and was explained to the teachers and students in workshops at the beginning of the semester. The LMS manual needs to provide accessible text and images in files, documents, LMS pages, and web pages to meet the needs of diverse learners (images) Daniel C. (2020) and QM (quality matter, 2020) encourage to develop the of the digital platform.

The research outcome shows difference in results in the learning outcomes. The workshops were recorded as videos in Microsoft Teams and were provided to the learners. The results from DAU QU are compared with the results from the students. Figure 11 shows the results between the DAU QU and the students.

The results for ARC404 showed the same response of 2.6/3 by the DAU QU and the Students. ARC302 also had the same result and evaluation by DAU QU and the students. There was a slight differentiation in the results of ARC213: the DAU QU evaluated the course lower than the students, 2.6/3, while the students evaluated it at 2.8/3. For ARC211, the DAU evaluated the course higher than the students, at 2.8/3, while the students evaluated it at 2.6/3.

In assessing the quality of work and if it was presented in LMS to the students, two remarks were received from the Quality Unit: one about the policies not being pasted in LMS and the second about ARC213 needing more details for the students. From the students' point of view, they evaluated the course in terms of personal impact from the teacher and the difficulties in the course; if they found the course easy for them, they gave a high impact. If the course was difficult for them, they gave a lower impact. Figure 16. shows the results of the e-learning and teaching by The University QU for all courses in Architecture Engineering. Program 20-21-2

Answering the Hypothies Questions
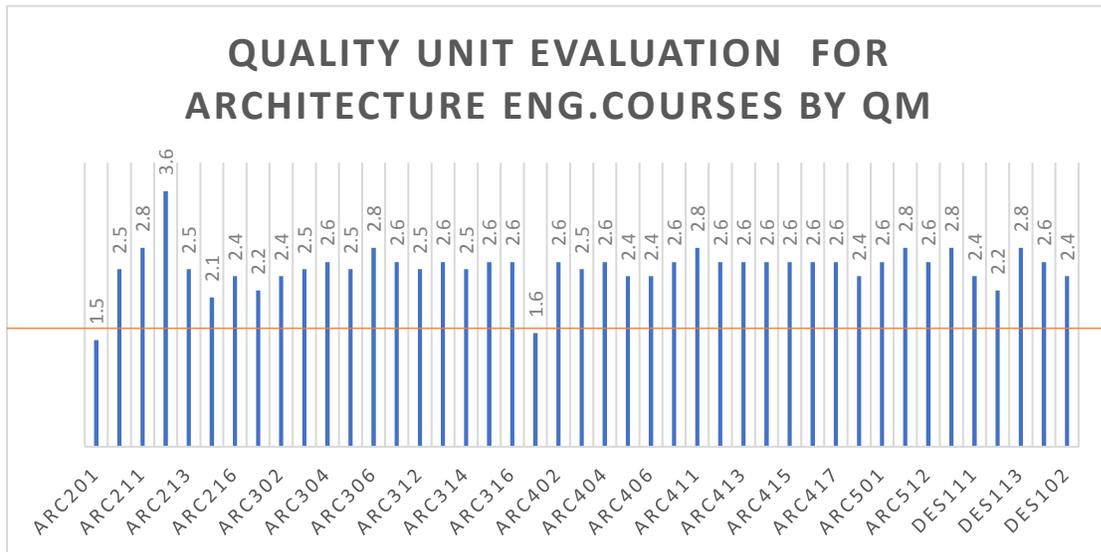
Figure 2.16. The results of the e-learning and teaching by The University QU for all courses in Architecture Engineering. Program 20-21-2.

The first hypothesis the LMS apply the Quality matter standards

The university Quality Unit is applying the Quality Matter evaluation to all Architecture courses see figure 16.

Ansering the second hypothes all the e-courses are passed the evaluation by 95% only 5% (2 courses) not pass Figure 16

Answering the third hypothes The improvement plan for those courses (5%) of total courses is to offer them training workshops by the quality unit.

6. Conclusions

The research recommends that posting the policies in the LMS as a PDF file or in the Students' Manual, and demonstrate the computer skills needed in the course for the course since the course is delivered online. The student needs to apply his/her knowledge in computer skills in the proper way. In addition, the research recommends that the teacher should explain the prerequisite knowledge in the discipline and/or any required competencies to the students, such as writing, analysing, drawing sketches, working in groups, and discussing in design juries.

The research recommends that the teacher should write an introduction about him/herself in the LMS, mentioning their email, phone and office phone numbers, and office hours. Additionally, a video about the CV can be uploaded. Also, the teacher should ensure that the assignment suits the learning outcomes. In addition, the course should demonstrate the required knowledge skills and values according to the PLO and the CLO. Additionally, they should ensure that all the assignments reflect the learning outcome.

Assessment and measurement criteria should be clearly explained to the student in the course syllabus.

The course material should be updated regularly by 25% according to the market needs.

A variety of teaching materials should be used, such as lectures, lecture videos, eBooks, teacher websites, teacher blogs, and YouTube teacher channels. The variety of learning

activities and learner interaction should be explained to the students at the beginning of the semester, and what the teacher is expecting from the students in each assignment and activity should be clearly explained. The teacher should be sure that course tools promote learner engagement and active learning. Tools such as teacher websites, blogs, YouTube channels, smartboards, whiteboards, and 3D project discussions should be provided online.

The teacher should use a variety of technologies in the course, such as virtual site visits, virtual building visits, virtual reality, and virtual labs.

Learner support should be offered, such as IT support, digital library, WIFI, data, IT support for the final exam, LMS support, SIS support, and email support. The course navigation facilitates ease of use (new LMS). The course design facilitates readability and should be explained to teachers and students through workshops at the beginning of the semester.

LMS manual should be provided. Accessibility to LMS should be suitable to the teachers and the students.

Course resources should include alternative means of access to multimedia content in a format that meets the needs of diverse learners. The workshops should be recorded as videos and given to the learners.

Last, the teaching and learning procedures should be from the heart of the teacher to the mind of the students to ensure that the course achieves the QM learning outcome standards and provides a human sense to the students during this period of COVID-19

The students should share in the interactive learning by applying different teaching strategies such as PowerPoint presentation, reverse learning, groupwork discussion, design Jory discussion, evaluate their work, etc.

7. Suggestions for Future Research
1) Using different technologies in e-learning and teaching
2) Using different teaching strategies in e-learning in Architecture program

Acknowledgement

References

ABET. (2019). *CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS.* USA: Copyright © 2018 by ABET. Retrieved from https://www.abet.org/wp-content/uploads/2015/10/E001-16-17-EAC-Criteria-10-20-15

Alizadeh, M. (2019). Evaluating a blended course for Japanese learners of English: why Quality Matters. *International Journal of Educational Technology in Higher Education, 16.* https://doi.org/10.1186/s41239-019-0137-2

Daniel, C. (2020). Innovative Teaching and Learning Process during COVID 19. In A. S. Thomas (Ed.), *Innovative Teaching and Learning Process during COVID 19* (pp. 1-80). Kerala Agricultural University, INDIA.

DAU. (2021). *Quality Standards for E Courses.* Riyadh City, Saudi Arabia Kingdom.

Education, Swedisn NationalAgency for Higher. (2008). *E-learning quality Aspects and criteria for evaluation of e-learning in higher education.* Swidish: Swedisn National Agency. Retrieved from https://scholar.google.com/scholar?q=E-

learning+quality+Aspects+and+criteria+for+evaluation+of+e-learning+in+higher+education&hl=ar&as_sdt=0&as_vis=1&oi=scholart

ETEC. (2020). *National Engineering Learning Outcomes.* KSA: Engineering Learning Outcomes Committee, National Qualifications Framework, ETEC.

Fauzi, Irfan. (2020). Teachers' Elementary School in Online Learning of COVID-19. *Journal Iqra, 5*(1). https://doi.org/10.25217/ji.v5i1.914

Ghobrini, R. E. (2020). Synergizing Facebook and YouTube for e-Teaching Grammar during Covid-19. *International Journal of Research in Education and Science.* https://doi.org/10.26697/ijes.2020.4.8

Goda, Nesrin. (2020). COVID-19 AND ONLINE TEACHING IN HIGHER EDUCATION: A CASE STUDY OF PRIVATE COLLEGES - SAUDI ARABIA. *International Journal Of English and Studies (IJOES), 2*(10). Retrieved from https://www.researchgate.net/publication/345898419_COVID-19_AND_ONLINE_TEACHING_IN_HIGHER_EDUCATION_A_CASE_STUDY_OF_PRIVATE_COLLEGES_-SAUDI_ARABIA.

https://www.qualitymatters.org/sites/default/files/research-docs-pdfs/2019-K-12-Dissertation-Literature-Review.pdf

IEA. (2007). *How do we build mutual understanding among nations about the quality of engineers who enter the globally connected workplace?* UK: Washington Accord. Retrieved from https://www.ieagreements.org/accords/washington/

Jassim, L. L. (2020). Using E-Learning Technologies in Teaching and Learning Process. *International Journal of Social Learning, 1*(1). https://doi.org/10.47134/ijsl.v1i1.1

Khogali, Hind. (2020). The Effect of COVID-19 CORONA VIRUS on Sustainable Teaching and Learning in Architecture Engineering. *Journal of Applied Science, 14*(8). https://doi.org/10.5539/mas.v14n8p44

Mammadova I. (2020). TEACHING WITH TECHNOLOGY, LEARNING BY DESIGN. *Bulletin of Science and Practice, 6*(12). https://doi.org/10.33619/2414-2948/61/52

Mark, Th. (2021). The *Effect of CORONA on Teaching and Students in Saudi Arabia.* King Faisal Center for Research, and Islamic Studies. Saudi Arabia.

Mark, Th. (2021). The Kingdom's Response to the COVID-19 Outbreak: Steps That Have Been Taken to Date. *King Faisal Center for Research, and Islamic Studies. Saudi Arabia.*

Matter, Q. Q. (2020). *Grounded in research. Driven by best practices. A community that puts learners first.* Retrieved from https://www.qualitymatters.org

Mseleku, Z. (2020). A Literature Review of E-Learning and E-Teaching in the Era of Covid-19 Pandemic. *International Journal of Innovative Science and Research Technology, 5*(10). Retrieved from https://www.researchgate.net/publication/344927168

Oyediran, Wasiu Oyeleke. (2020). Prospects and limitations of e-learning application in private tertiary. *Heliyon, 6*(11). https://doi.org/10.1016/j.heliyon.2020.e05457

QM. (2019). *Quality Matter. Higher Education Literature Review Summary,* DAU. Quality Standards for E- Courses. Riyadh City, Saudi Arabia Kingdom, KSA. Retrieved from https://www.qualitymatters.org/sites/default/files/research-docs-pdfs/2019-Higher-Education-Literature-Review-Summary-Report.pdf

QM. (2020). *Grounded in research. Driven by best practices. A community that puts learners first.* Retrieved from https://www.qualitymatters.org/

QM. (2020). *quality matter.* Administrative Supports for Digital Accessibility: Policies and Processes: quality matter.org

QM. (2021). *Quality Matter.* Quality Matter Checklist: quality matter.org

Sadaf, A. (2019). Student Perceptions of the Impact of Quality Matters-Certified Online Courses on Their Learning and Engagement. *Online Learning Journal.* https://doi.org/10.24059/olj.v23i4.2009

Sharma, A. (2017). Learning Management System for Virtual Teaching and Learning. *World Academics Journal of Engineering Science, 4*(1), 5-7. Retrieved from https://www.researchgate.net/publication/345983706

Shattuck, Barbra Burch, & Kay. (2019). QM K-12 Online Learning Research. *QM Research and Development,* 1-10.

Sireesha1, N. (2020). Teaching to Learn or Learning to Teach-? A Review on LMS. *TEST Engineering and Management.* Retrieved from https://www.researchgate.net/publication/344388068

Sultana, Nosaiba. (2020). E-Learning: Covid19 Pandemic: Impact and strategies for education sector in India. *International Journal of Creative Research Thoughts (IJCRT).* Retrieved from https://www.researchgate.net/publication/348786049_E-Learning_Covid19_Pandemic_Impact_and_strategies_for_education_sector_in_India

Vaid, Shashank. (2020). Deep learning COVID-19 detection bias: accuracy. *International Orthopaedics, 44.* https://doi.org/10.1007/s00264-020-04609-7

Webinar, Sudanes Research Foundation. (2020). The Effect of COVID-19 in Teaching and Learning in Architecture Engineering Colleges. *YouTube.* 20 Sat. June. Retrieved from https://www.youtube.com/watch?v=ehp0Ufis-QI&t=6s

Appendix

Table 12. Shows the applied assessment method by QM checklist on this research with 5 points of evaluation

	Strongly Agree	Agree	Average	Disagree	Strongly Disagree	The Average Result for the Question
	80-100	70-80	50-70	40-30	30-1	
	5/5	4/4	3/3	2/2	1/1	
	404	213	302	211		

1) Course Overview and Introduction

1.1 Instructions made clear; how to get started and where to find various course components.

1.2 Learners are introduced to the purpose and structure of

the course.

1.3	Communication expectations for online discussions. Email and other forms of interaction are clearly stated.
1.4	Courses and institutional policies with which the learner is expected to comply are clearly stated within the course, or a link to current policies is provided.
1.5	Minimum technology requirements for the course are clearly stated, and information on how to obtain the technologies are provided.
1.6	Computer skills and digital information literacy skills expected of the learner are clearly stated.
1.7	Expectations for prerequisite and knowledge in the discipline and/or any required competencies are clearly stated.
1.8	The self-introduction of the instructor is professional and is available online.
1.9	Learners are asked to introduce themselves to the class.

2) Learning Objectives (Competencies)

2.1	The course learning objectives, or course/program competencies describe outcomes that are measurable.
2.2	The module/unit level learning objectives or competencies describe outcomes that are measurable and consistent with the course level objectives or competencies.
2.3	Learning objectives or competencies are stated Clearly, written from the learner's perspective, and prominently located in the course.
2.4	The relationship between learning objectives / competencies and learning activities are clearly stated.
2.5	The learning objectives or competencies are suited to the level of the course.

3) Assessment and Measurement

3.1	The assessments measure the achievement of the stated learning objectives or competencies.
3.2	The course grading policy is stated clearly in the beginning of the course.
3.3	Specific and descriptive criteria are provided for the evaluation of learners' work, and their

connection to the course grading policy is clearly explained.

3.4	The assessments used are sequenced, varied, and suited to the level of the course.
3.5	The course provides learners with multiple opportunities to track their learning progress with timely feedback.

4) Instructional Materials

4.1	The instructional materials contribute to the achievement of the stated learning objectives or competencies.
4.2	The relationship between the use of instructional materials in the course and completing learning activities is clearly explained.
4.3	The course models the academic integrity expected of learners by providing both source references and permissions for use of instructional materials.
4.4	The instructional materials represent up-to-date theory and practice in the discipline.
4.5	A variety of instructional materials is used in the course.

5) Learning Activities and Learner Interaction

5.1	The learning activities promote the achievement of the stated learning objectives or competencies.
5.2	Learning activities provide opportunities for interaction that supports active learning.
5.3	The instructors plan for interacting with learners during the course is clearly stated.
5.4	The requirements for learner interaction are clearly stated.

6) Course Technology

6.1	The tools used in the course support the learning objectives or competencies.
6.2	Course tools promote learner engagement and active learning.
6.3	A variety of technology is used in the course.

6.4	The course provides learners with information on protecting their data and privacy.

7) Learner Support

7.1	The course instructions articulate or link a clear description of the technical support offered and how to obtain it.
7.2	Course instructions articulate or link the institutions accessibility policies and services.
7.3	Course instructions articulate or link the institutions academic support services and resources that can help learners succeed in the course.
7.4	Course instructions articulate or link the institutions student services and resources that can help learners succeed.

8) Accessibility and Usability

8.1	Course navigation facilitates ease of use.
8.2	The course design facilitates readability
8.3	The course provides accessible text and images in files, documents, LMS pages, and web pages to meet the needs of diverse learners.
8.4	The course provides alternative means of access to multimedia content in formats that meet the needs of diverse learners.
8.5	Course multimedia facilitate ease of use.

Source: designed by the researcher.

CHAPTER THREE

The Effect of COVID-19 on Academic Social Life in Riyadh with a Focus on the Outdoor Environment

The Effect of COVID-19 on Academic Social Life in Riyadh with a Focus on the Outdoor Environment

Khogali, H., 2021

Abstract

On 18 March 2020, the World Health Organization announced that the coronavirus disease 2019 (COVID-19) pandemic had reached global pandemic status. The Ministry of Health in Saudi Arabia implemented a COVID-19 lockdown that lasted for four months. After the period of restrictions ended, people were supposed to return to their normal social lives; however, the lockdown had a psychological impact on people without them being aware of it. This research aimed to study the effect of COVID-19 on social life, mainly focusing on six public activities: visiting shopping malls, mosques, open spaces, interior space, psychological effect, and occupational aspects. The Method survey was distributed during lockdown including the six focus areas and collected using Google Forms. Also, a computer program simulation (ENVI-MET) was used to study and develop an outdoor environment. The research focuses on the outdoor environment to find solutions on a sample used Al Rouda Park in Riyadh. The results demonstrated that people are slowly returning to their social lives during the COVID-19 pandemic by steadily visiting shopping malls, mosques, and open spaces and half of respondents stay at home fearing COVID-19. The research concluded that people should apply health procedures during ongoing time in studied locations and should manage the elaborated psychological effects.

Keywords: COVID-19, sustainability, social life, psychological impacts, occupational aspects

3.1. Introduction

Although the coronavirus disease 2019 (COVID-19) lockdown ended in June 2020, people remained at home. A small percentage of people are, however, slowly resuming their social lives. This makes studying the impact of COVID-19 on social life crucial, especially for the three main activities in Saudi Arabia: shopping at malls, praying at mosques, and visiting open spaces. Therefore, accommodations must be made (e.g., shaping the design of interiors and outdoor environments), and studying the psychological effects and occupational aspect is required.

The literature reviewed regarding the six focus areas; Echegaray, produced a report that discussed many topics, for example, the post-COVID-19 world, implementing sustainable lifestyles, work, workplaces, family, love, social life, well-being, personal health, education, training, leisure, entertainment, consumption, mobility, housing, living spaces, citizenship, interactions with the state, financial security, social equality, health care provision, and medical reassurances. Among these areas, we focused on the effect of COVID-19 on social life after the end of the lockdown, especially regarding designing interior and exterior spaces, for example, shopping malls and mosques, and its psychological effects on people (Echegaray, F., 2020). Abid, discussed COVID-19 in daily life and stated that it affects social distancing with peers and family; decreases national and international travel; disrupts the celebrations of cultural, religious, and festive events;

causes undue stress among the population; results in the closure of hotels, restaurants, and religious places; poor cash flow in the market (Abid Haleem, R. V., 2020). Jiang stated that social distancing involved maintaining 1.5 m between individuals, which can prevent the spread of most respiratory infectious diseases (Jiang1, Meirui, 2020). People can return to their lives by maintaining this distance and can reduce the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by wearing masks and washing hands. The aim of this study is to contextually identify and assess the consequences of SARS-Covid-19 on social life in Riyadh City by the distributed survey to academics in three universities and record their response in designing the interior space, designing the outdoor space, praying in mosques, visiting shopping malls and its psychological effect on people.

3.2. Literature Review

3.2.1 Definition of Social Life

Webster stated that Social life is defined as the part of an individual's time that is spent doing enjoyable things with others, as investigated by (Webster, M., 2020) Minor stated that Life as a notion that is difficult to define has also been investigated social life is about the existence and the activity of an organic being or the ability to be born, develop, reproduce, and die. The social is what is linked to society: a community of individuals that share a common culture or interest (Minor, M. T., 2018).

The following are the tentative parameters that impact health:

- The impact of designs on interior spaces.
- Redesigning public spaces.
- The impact on praying in the mosque.
- The impact on visiting shopping malls.
- The impact on psychological well-being.
- Occupation aspects

We focused on the effects of COVID-19 in five areas, namely, interior, and exterior spaces, mosques, and shopping malls, and the impact on psychological well-being, because COVID-19 has affected these parameters.

3.2.2 Impact on the Design of Interior Spaces

In this regard, Solution discussed the future trends in housing interior design and the associated factors, including building systems, air ventilation, and filtration, relative humidity, and temperature. Figure 1 shows social distancing in interior spaces (Solution, E. D., 2020). Sameh focused on creating resilient cities in Jeddah after the COVID-19 pandemic (Sameh, S., 2020). They discussed a webinar regarding the new implementation of green buildings in Saudi Arabia. Riyadh. The capital and financial center of Saudi Arabia was also investigated regarding the challenges facing green buildings; the recommendation was that the focus during the COVID-19 pandemic should be on human health (Al-Serf, M., 2020) Al-Serf discussed how to implement the Internet of things to support sustainability in the Mena region, focusing on smart solutions in green buildings (Al-Serf, M., 2020). Figure 1 shows social distancing in interior spaces.

Figure 3.1. Social distancing in interior spaces

3.2.3 Redesigning Public Spaces

In this context, Scott reported the risks of COVID-19 in the long term and stated that, if left unchecked, there would be a risk that inequalities and social deprivation will increase. However, these risks provide an opportunity to build a better world that should be realized. Scott agreed that the interior and exterior landscapes must be reshaped to ameliorate the risks of COVID-19. Figure 2 shows the different solutions applied in outdoor spaces (Scott, J., May 2020).

Cortesãoa discussed the sustainability and thermal comfort of public spaces and stated that designers should study thermal comfort in outdoor spaces by studying wind directions, solar angles that provide benefits from trees, and the designs of spaces to provide comfort (Corvacho, H., 2020 Jalal studied the impact of evolving building morphologies on thermal comfort in public spaces in hot, arid climates, and stated that trees and sitting areas with social distancing should be provided (Jalal, O. M., 2020). Jiang also discussed social distancing (Jiang, 2020). Sameh provided a webinar on the influence of COVID-19 and quarantine on lifestyle and home design (Sameh, S., 2020). Besides, Echegaray stated that the world is anticipating post-COVID-19 life and the implications for sustainable lifestyles from a Global South perspective (Echegaray, F., 2020) Figure 2 shows solutions applied in outdoor spaces discussed in webinar by Jalal.
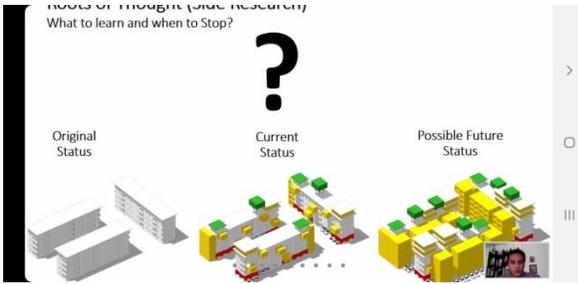
Figure 3. 2. Solutions applied in outdoor spaces. Source: Jalal (Jalal, O. M., 2020).

3.2.4 Impact on Designing Mosques

During the COVID-19 pandemic (from Feb.2020 to May 2020), people have rarely visited mosques: some people visit the mosques once a week, others twice, and most of them are not visiting at all. Health procedures were applied in all mosques. Moreover, (Authority, P. H., 2021) and (Health, M., 2021), published the protocols of the Ministry of Health and procedures used inside the mosques, including:

- Hygiene, physical distancing, and working remotely.
- Toilets: applying social distancing and supplying liquid soap.
- Permitting open toilets and ablution places in mosques, provided that a worker is designated to disinfect them after each obligatory prayer.
- Symptom monitoring and reporting.
- Increasing COVID-19 awareness in mosques.
- More cautions were added by the government in Riyadh regarding praying in the mosques during Ramadan 2021, such as regular cleaning, bringing your own prayer carpet. Apply Tawakkalna software.

Figure 3.3. Mosque designs. Source: (News, A., 2021)

3.2.5 Impact on the Operation of Shopping Malls

People have slowly started to visit shopping malls, which are also applying social distancing and health procedures. News discussed the health procedures in shopping malls (News, A., 2021). Including:

- Shoppers must undergo temperature checks at the entrance to stores.
- They are required to keep two meters away from each other and wear face masks and gloves.
- Children under the age of 15 years are not allowed entry.
- Entertainment venues, cafes, and restaurants in shopping centers are to remain closed according to COVID-19 regulations.
- Applying the smart application to reduce to measure the number of people inside the shopping mall to be within 50 persons/hours.

(a)

(b)

(c)   (d)

Figure 3.4. Impact of COVID-19 on shopping malls. Source: (News, A., 2021)

3.2.6 Psychological Impacts

On 18 March 2020, the World Health Organization issued a report related to the mental health and psychosocial concerns due to COVID-19 and provided instructions and social considerations to apply during the COVID-19 outbreak. Blue Nile TV presented interviews with famous program presenters affected by COVID-19 and asked them about the psychological impact of COVID-19 and how they recommend overcoming the disease; They said that the symptoms were a headache, coughing, fatigue, a sore throat, and a loss of taste or smell (Blue -Nile., 2020).

Prevention stated that the psychological effects started with individuals refusing to admit that they had COVID-19 when the fever started. Subsequently, they took the test and received a positive result. At this time, they began admitting that they had the disease and visited a specialized therapist. There was no specific treatment. The recommended medical advice was to take antibiotics and pain relief and to isolate themselves from their family and the community; this protocol resulted in deep psychological impacts (Prevention, C. O., 2020).

Also, the WHO reported an increasing number of incidences of domestic violence, divorce, and suicide (WHO, 2020).

3.2.7 Occupational Aspects

Neeraj stated that COVID-19 has deep occupation effect on the Academics. Mishar stated that COVID-19 has affected our life, our daily routine, lifestyle, office wok and the future plan was interrupted, with focus on occupation it affected how people access and undertake with COVID-19 pandemic, access resources, mobility, social isolation, issues with mental health and well being (Neeraj, M., 2020). Also, Lachan discussed the impact of COVID-19 on the teaching workforce, a new focus on remote learning, new protocols in health and safety, distance learning, working conditions, unemployment in other sectors (Lachlan, L., 2020). In addion Jain highlighted the important of training programs to the teachers to fill the gap in accessibility, usage, and e-teaching and learning skills (Jain, S., 2021). Khogali discussed her university conditions having its own experience regarding the occupational aspect stated that teaching in Saudi Arabia was changed to e-learning as a special case during April to May 2020 and changed to blending learning from Sep 2020 to April 2021, and so were the practical courses on campus, and the theoretical courses online (Khogali, H., 2020).

3.2.8 The Latest Researches in the Field of the Study

Kukenkov discussed the organization of interior spaces using new approaches regarding the assimilation of researched objects, considering color-tonal modeling, and expanding the scope of the organization of space-associated and structural elements (Kukenkov, V., 2020). Gruenwald stated that COVID-19 affected outdoor advertisements in the form of

signs and billboards, reporting that we can use QR codes and code names specific to a campaign, along with hashtags on social media like Instagram, Facebook, and Twitter as solutions to this problem (Gruenwald, H., 2021). Freeman discussed COVID-19 and outdoor safety in- depth and highlighted some solutions, such as reducing the number of people entering the public park, staying 2 meters away from others, limiting the access to activities, managing the outdoor space, and introducing mental health agencies to deal with COVID-19-related stress (Freeman, Sh., 2020). Clouston, in this study, suggested how the outdoor transmission of COVID-19 may occur by noting that the risk of transmission of COVID-19 in the summer was highest on days when the wind was reduced (Clouston, S. A., 2021). Lannoy discussed the importance of outdoor space for children and youth, with outdoor play being important for children's physical and mental health; therefore, provincial policies related to COVID-19 and outdoor play are needed (Lannoy, L. d., 2020).

Xie analyzed the importance of outdoor space and stated that that urban parks and large outdoor open spaces can provide residents with a place for safe outdoor activities and social interaction in a green environment during a pandemic (Xie J., Luo S., Furuya K., & Sun D., 2020). Barbarossa examined the importance of transportation during the COVID-19 pandemic in Italy to make up for lost time and to start a green revolution that is aimed at quickly decarbonizing urban transport and enhancing cycling and walking through the city (Barbarossa L., 2020). Hamidi highlighted the importance of counties that are tightly linked together through economic, social, and commuting relationships to reduce the number of COVID-19-related deaths (Hamidi, S., Sabouri, S., & Ewing, R., 2020).

Batty considered the impact of COVID-19 on the global economy, noting it will need time to recover, maybe a generation, and highlighted the importance of using the new technology and document (Batty, M., 2020) he found that in most countries included in the analysis, park visitation had increased since 16 February 2020 compared with visitor numbers prior to the COVID-19 pandemic (Geng, D., Innes, J., Wu, W. et al., 2021). D'Ascanio highlighted the importance of using of graphic, visual, and multimedia contributions to the landscapes that have been generated in the consciousness of the inhabitants through their perceptions during the quarantine and all phases of the pandemic (D'Ascanio, R., & Mondelli, F. P. editors, 2021). Bravo collected information on this pandemic, including photos and videos. While about 40% of the global population was under coronavirus lockdown, we announced our brand new initiative called 2020: A Year without Public Space under the COVID-19 Pandemic, which was developed in the early stages to help people cope with the health emergency (Bravo, L., & Tieben, H. editors, 2020). Honey reported the importance of using public space for recovery during the pandemic, and cities will be shaped because of the social distancing in the landscape (Honey, J., 2021). Broudehoux answered the question: Will the COVID-19 pandemic prompt a shift to healthier cities that focus on wellness rather than functional and economic aspects? The report paradoxically concluded that COVID-19 may also have long-term public health benefits, promoting a more active, self-reliant, and supportive population (Broudehoux, A., 2021). Alsutan stated that the international cases of COVID-19 were high, but in Saudi Arabia, the fatality rate had been very low (about 3.8%) because of the strict measures applied by the Ministry of Health and the government, which were followed by citizens (Sultan, F. A., 2021). Abdulmajeed reported that schools and universities need guidance in implementing a clear and effective strategy for students to navigate the coming academic year and expand the academic and psychological counseling, especially for vulnerable populations (Alkhamees1, A. A., 2020). Maryam researched the COVID-19 pandemic in Saudi Arabia and noted the importance of having a research center and calling center for COVID-19 data (Awaji, M. A., 2020). Mark considered the effect of COVID-19 on education in Saudi Arabia and found that most of the schools changed to online teaching and learning; the platform, strong Internet, and mobile and computer devices all are available in Saudi Arabia to 90% of the population, contributing to the success of e-learning

education in Saudi Arabia. Mark and Khogali investigated e-learning and teaching in Saudi Arabia. Mark analyzed the effect of COVID-19 on public health, the economy, and migration in Saudi Arabia (Mark, Th., 2021) and (Khogali, H., 2020).

Therefore, we believe that the consequences of COVID-19 pandemic crisis could be even more evident. This Novel research will represent new sources of information regarding the interiorspace, designing the outdoor space, praying in the mosque, visiting the shopping malls, and its psychological effect and occupational aspect *on people.*

Table 3.1. Literature and Hypotheses on aspects of impacts

Main previous studies	design of interior spaces	design of outdoor spaces	praying in mosques	visiting shopping malls	psychological effects	Occupational effects	Research Output
	Duration time	Health procedures Including social distancing	psychological effects				*No one of these previous researches talked about the duration time
(Abid H., & R. V., 2020). (Jaing, S., 2021).		Social distancing			Stress		More health procedures are applied by the government in health procedures Reflecting to re-design the interior space and exterior space
(Solution, E. D., 2020). (Al-Serf, M., 2020). (Sameh, S., 2020). (Echegaray, F., 2020). (Kukenkov, V., 2020).	Natural ventilation, smart solutions in housing. Home design Color	Human Health					*Change color *Maximize the space *plants Practice positive activities at home

Main previous studies	design of interior spaces	design of outdoor spaces	praying in mosques	visiting shopping malls	psychological effects	Occupational effects	Research Output
(Scott, J., May 2020). (Gruenwald, H., 2021). (Honey, J., 2021) (Clouston, S. A., 2021). (Lannoy, L. d., 2020). (Xie J, Luo S, Furuya K, Sun D., 2020). (Barbarossa L., 2020). (Hamidi, S., Sabouri, S. and Ewing, R., 2020). (Batty, M. The Coronavirus crisis, 2020) (Geng, D., Innes, J., Wu, W. et al., 2021).		-Re shaped the outdoor space - advertisements - reducing the number of people entering the public park - transportation -global economy -global social					*Check point should be provided *Redesign the grass with social distancing *duration time *study of the environmental issues by ENVI-MET
(Corvacho, Helena, June, 2020) (Jalal, O. M., 2020). (Freeman, Sh., 2020).		Studying thermal comfort in the outdoor environment					
(Authority, P. H., 2021) (Health, M., 2021).			-Health procedures -Social distancing				
(News, A., 2020)			Health procedures -Social distancing				
(Blue -Nile., 2020), (Prevention, C. O., 2020), (WHO, 2020). (Freeman, Sh., 2020).					-headache, coughing, fatigue, a sore throat, and a loss of taste or smell Domestic		Positive action should be done In interior space and outdoor space and shopping mall

Main previous studies	design of interior spaces	design of outdoor spaces	of praying in mosques	in visiting shopping malls	psychological effects	Occupational effects	Research Output
					-violence, divorce, and suicide - children's physical and mental health		
(Park, Weather, 2021). (Lachlan, L., 2020). (Jain, S., 2021).					Loss of employment in some sectors -health and safety impact -distance learning -training and workshops for the challenges		-Blending learning is applied recently -e-learning -online webinar -online conferences -training and workshops

Passing through the literature during the last three years the researcher found that none of these researches discussed the duration time of visiting the shopping mall, visiting the park, and praying in the mosque, so at this point, this research is investigating empirical data in this area. Also, Echegaray, Abid, Jianl, Authority, Health, News investigated the health procedures in general during covid-19, (Echegaray, F., 2020), (Abid H., 2020), (Jalal, O. M., 2020). (Authority, P. H., 2021), (Health, M., 2021), and (News, A., 2021); still, this research will investigate the specific area of activities in shopping mall, outdoor space, indoor space, mosques, psychological occupation, and will discuss the health procedures applied by the government and to which extents they are applied, the smart application could be used to minimize the number of visitors toward these places, smart passport showing if the person has taken the vaccine.

Solution, Al-Serf, Echegaray, and Authority discussed Natural ventilation, smart solutions in housing, home design, using Colour (Solution, E. D., 2020), (Al-Serf, M., 2020). (Al-Serf, M., 2020). (Sameh, S., 2020), (Echegaray, F., 2020) this research will investigate more details on this area such as to maximize the interior space, use of plants, practice positive activities at home.

Some authors like Scott and others discussed reshaping of outdoor spaces, advertisements, reducing the number of people entering the public park, transportation, global economy, global societies. This research will investigate more details in Check point should be provided, redesign the grass with social distancing, duration time, the study of the environmental issues by ENVI-MET. Simulation software (ENVI-met version 4.3, ENVI-MET, Essen, Germany).

Blue -Nile and other authors discussed the negative signs for COVID-19 such as headache, coughing, fatigue, a sore throat, and a loss of taste or smell Domestic, violence, divorce, and suicide, children's physical and mental health (Blue -Nile., 2020), (Prevention, C. O., 2020), (WHO, 2020) and (Freeman, Sh., 2020). On the other hand, this research will

investigate the positive activities that could be applied at home or in the out space for better recovery of COVID-19.

3.3. Research Methodology

During the research timeframe from April 2020 to September 2021, a survey was distributed using the Google Forms software. The form recorded the responses from visitors to shopping malls, a mosque, and open spaces. The aim was to collect 282 individuals' responds as a sample for each focus area. In each focus area, there were three main questions about the duration, the health procedures, and the psychological effect of COVID-19. The survey had 15 questions in total.

Simulation software (ENVI-MET version 4.3, ENVI-Met, ENVI_met GmbH Kaninenberghöhe 2, 5136 Essen Germany) was used to analyze the urban areas and environmental issues (ENVI-MET, 2021). ENVI-met was used to study the environmental issue in Al Rouda Park in Riyad, Saudi Arabia.

The social life survey was distributed to academics at Dar Al Uloom University, Prince Noura University, and Prince Sultan University; professional groups on social media; students in secondary school. We targeted 282 people from the four areas. There were 141 respondents, including staff members, professors, teaching assistants, students, and professional engineers, which accounted for 50% of the sample. The survey was distributed again to increase the number of responses during March 2021; 141 responses from people in academia were received.
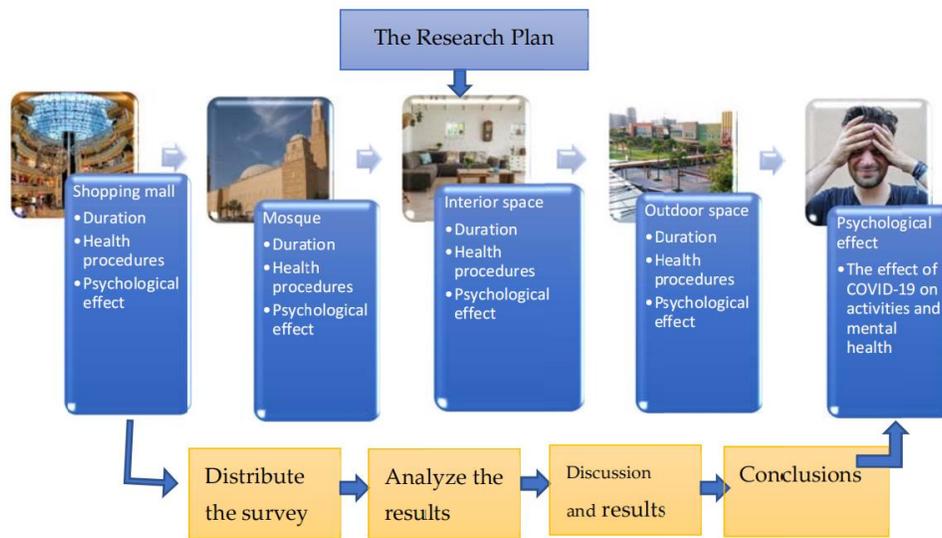
Figure 3.5. Flowchart of the research method plan to determine the effect of COVID-19 on the social life in Riyadh, including five focus areas: the impact on interior and exterior spaces, mosques, shopping malls, and psychological health

3.3.1 Research Hypotheses

1) COVID-19 is affecting the design of interior spaces.
2) COVID-19 is affecting the design of outdoor spaces.
3) COVID-19 is affecting praying in mosques.
4) COVID-19 is affecting visiting shopping malls.
5) COVID-19 has psychological effects on people.
6) COVID-19 has occupational effects on Academics.

3.4. Results

Figure 6 to 35 shows the results in percentages, distributed amongst the five possible responses: strongly agree, agree, average, disagree, and strongly disagree, more questions were offered. The survey was distributed from 30 September to 30 October 2020. Then, re-distributed during March-2021.

1) The self-reported responses of visitors to a shopping mall during the COVID-19 pandemic were collected. Of the respondents, 92% applied the health procedures, 50% would not go inside the shopping mall because they were afraid of contracting SARS-CoV-2, and 5.5% visited the shopping mall once per week.

2) The self-reported responses of visitors to a mosque were collected. Of all the respondents, 59.5% would not enter the mosque because they were afraid of contracting SARS-CoV-2, 15% visited the mosque, 80% of those that visited applied the health procedures, and 8.5% of participants visited the mosque once per week.

3) The self-reported responses of visitors to a park were collected. Of all the respondents, 29% visited the park once per week, 36% would not visit the park, 17% applied the health procedures, and 44.6% would spend time in the park itself because they were afraid of contracting SARS-CoV-2.

4) The self-reported responses on changing interior spaces were collected. Of all the respondents, 94% changed their interior spaces, 36% maximized their interior spaces, and 27% opened the windows to improve ventilation.

5) People spent their time during the COVID-19 pandemic practicing their hobbies and working from home. Specifically, of all the respondents, 41% were teaching online, 38% were watching television, 41% were using social media more than usual, 30% were walking, 30% were reading, 5.5% were visiting neighbors, 2.7% were riding a bicycle, and 8% were listening to the news about COVID-19. The respondents reported substantial hope for the future in terms of the pandemic disappearing and that life would return to normal.

6) The self-reported responses on occupation 40% of the respondents were practicing teaching online post-covid-19, 20% they were practicing online webinars, also 4% were publishing books and 7.8% were publishing scientific papers, and 23% were practicing the online webinars. 3% of the respondents lost their jobs, 19% of the respondents have no financial resources.

7) The result from simulaton the solar radiation in Figure 39 presented in red is the highest temperature (22 to 25°C) between the block buildings, the orange indicates 20 to 21°C; the yellow represents 19°C to 20°C, and green is the lowest temperature, between 15°C and 19°C. The prevailing wind direction is northwest, at 8 mph, and the humidity is 30% in March. Figures 6 to 10 show the results of the survey distributed to the Academics.
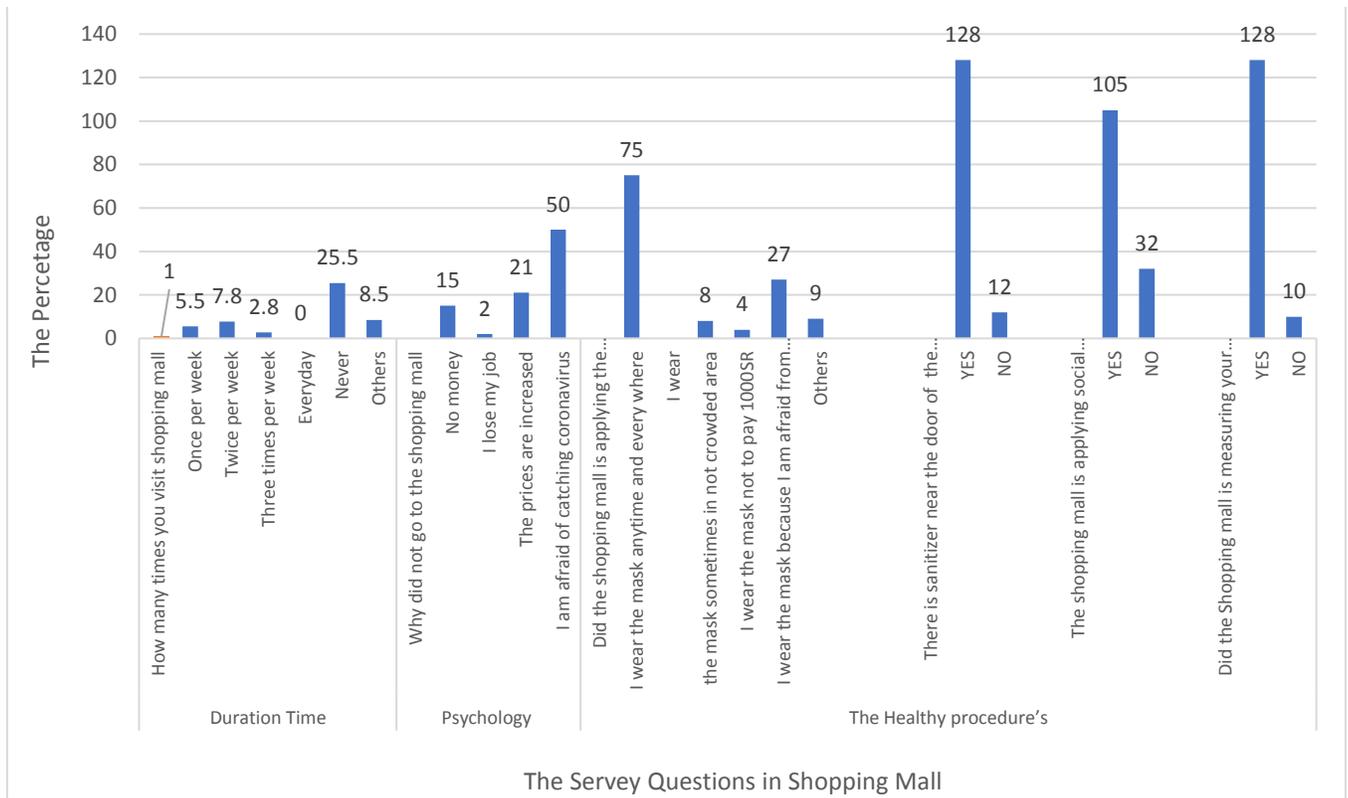
Figure 3. 6. Responses to shopping mall questions during the COVID-19 pandemic
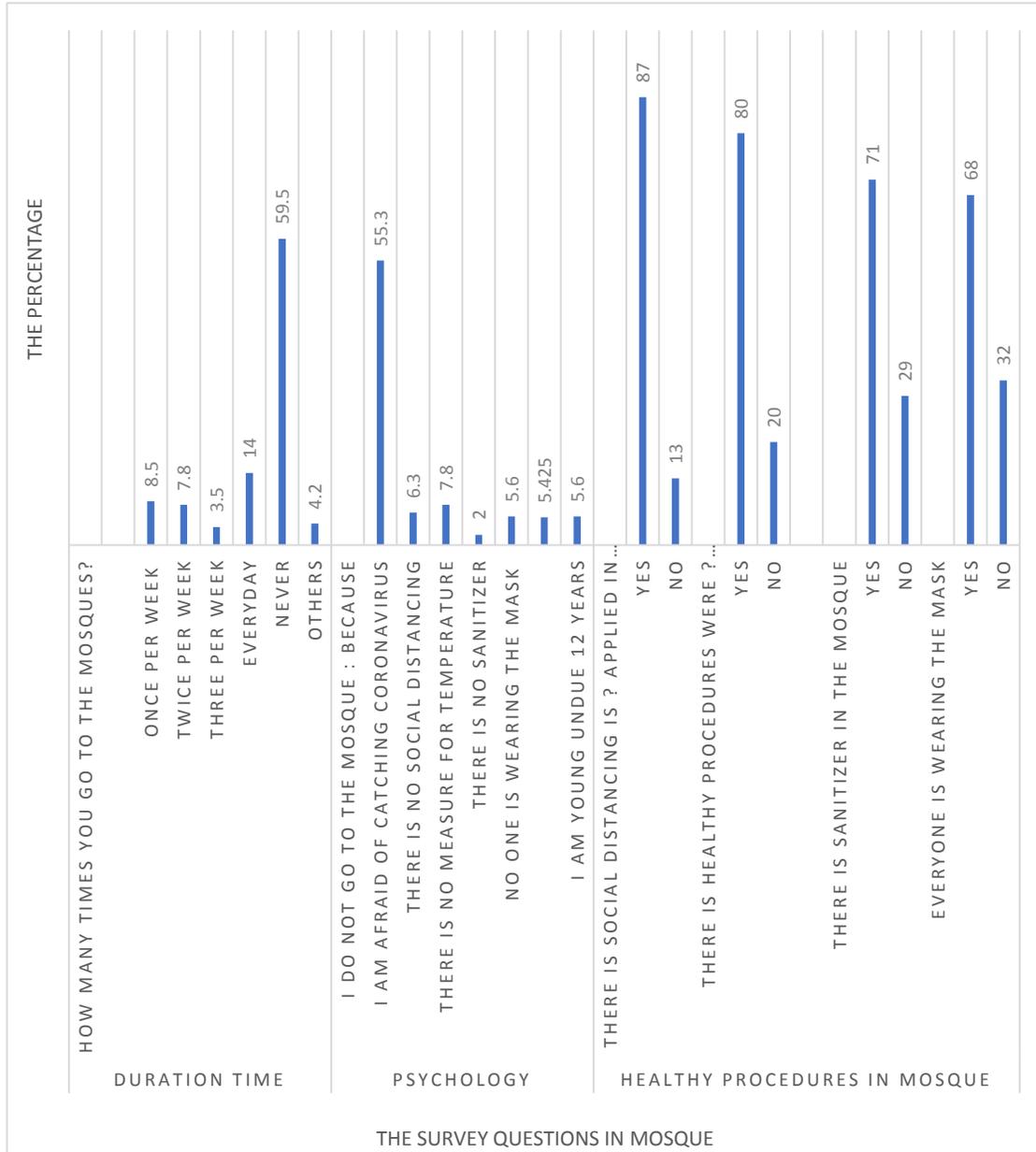
Figure 3.7. Responses to questions on visiting the mosque during the COVID-19 pandemic
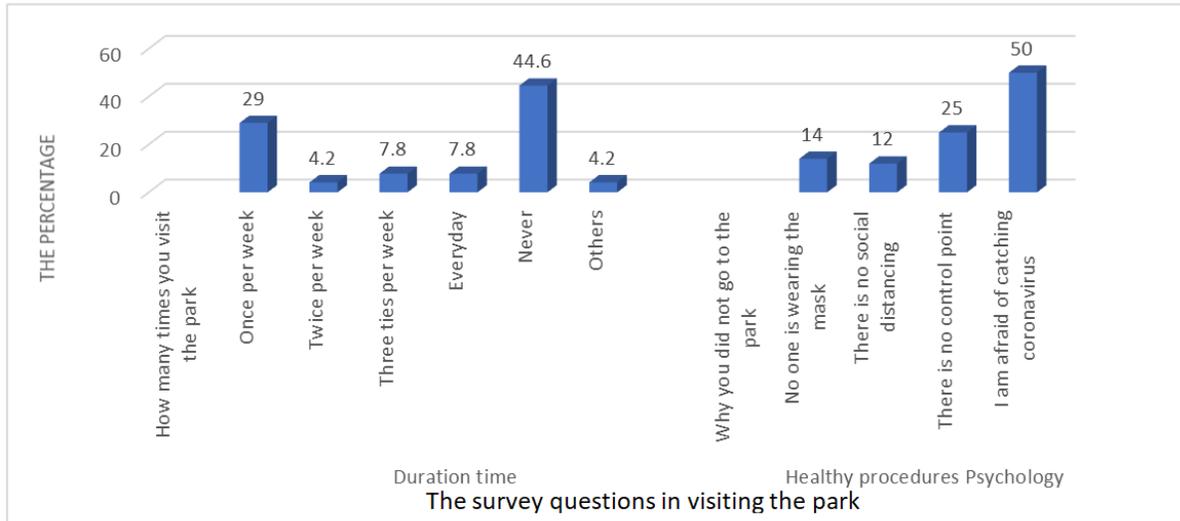
Figure 3.8. Responses to visiting parks during the COVID-19 pandemic
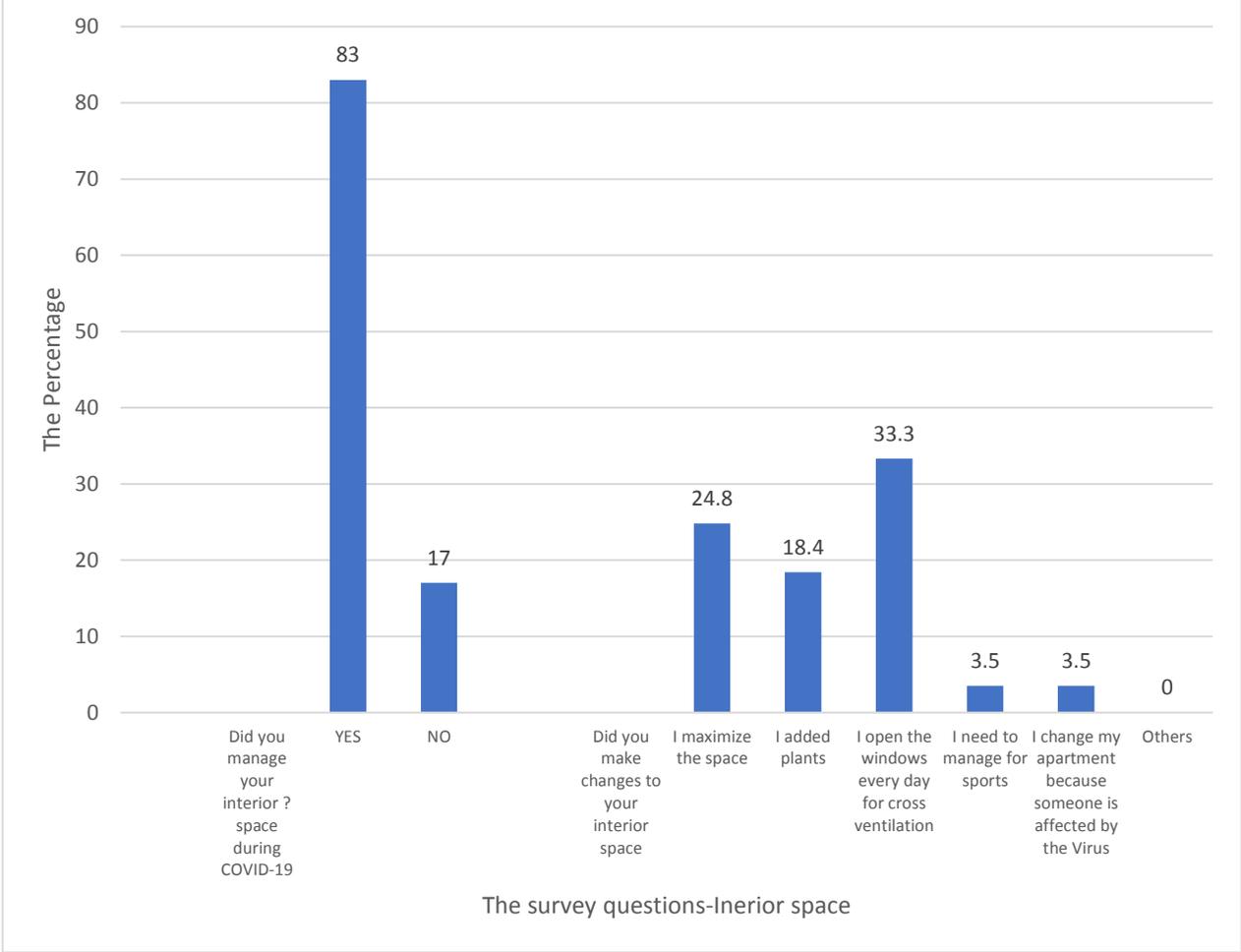
Figure 3.9. Managing interior space during the COVID-19 pandemic
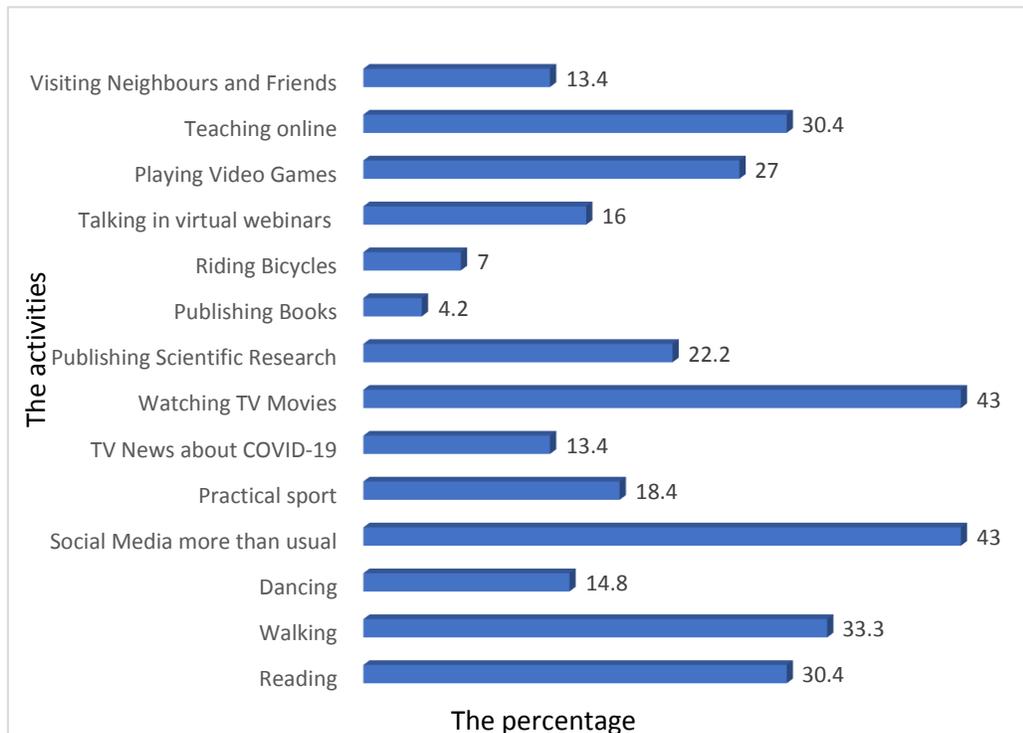
Figure 310. How people spent their time during the COVID-19 pandemic. The psychological and occupation impact

3.5. Discussion

A lockdown was implemented in response to the COVID-19 pandemic continuing during July and August 2020. Some individuals continued to stay at home, while others were slowly resuming their social life. Thus, studying the impact of COVID-19 on people's social lives is crucial, especially regarding the three main activities in Saudi Arabia: visiting shopping malls, mosques, and open spaces.

A survey was distributed on 30 September 2020 and collected on 30 October 2020; it was then redistributed on 15 March 2021 and collected on 31 March 2021 to increase the number of responses. The total number of responses was 141. The first question was on age. The survey had five groups: 10 to 20, 21 to 30, 31 to 40, 41 to 50, and 51 to 60 years.

The second question was on professions. Most of the respondents were students, a few were doctors or teaching assistants, while others were lecturers, professors, and engineers, most of the respondent are living in Saudi Arabia and few are living outside Saudi Arabia.

The first focus measured the response of the visitors regarding the shopping malls, mosques, indoor spaces, and outdoor spaces. The survey measured the duration, health procedures, and psychological effects and Occupation.

Alsutan stated that the international cases of COVID-19 are high, but in Saudi Arabia, the fatality rate has been very low because of the strict measures applied by the Ministry of Health and the government and people have followed the instructions (Sultan, F. A., 2021). Through the survey, we found that in six areas (interior and exterior spaces, shopping malls, mosques, parks, and occupation), the health procedures were applied to answer the hypothesis questions.

3.5.1 Managing Interior Spaces

Regarding _hypothesis 1_**:** COVID-19 is affecting the design of interior spaces.

(Kukenkov, V., 2020) discussed the organization of the interior space by considering new approaches to the assimilation of researched objects and color-tonal modeling, expanding the scope of the organization of space-associated and structure elements. Their research result agrees with ours.

COVID-19 affected the interior space, most of participants answered yes to the question regarding whether they changed their interior space, while few said no; most of the respondents managed their interior spaces, they added plants, opened windows daily to provide cross-ventilation, and sports activities. The research found that few changed their apartment because someone was affected by the virus.

During the lockdown due to the COVID-19 pandemic, most people spent their time in their homes. As a reflection of this situation, people could change their interior spaces to fit their everyday activities.
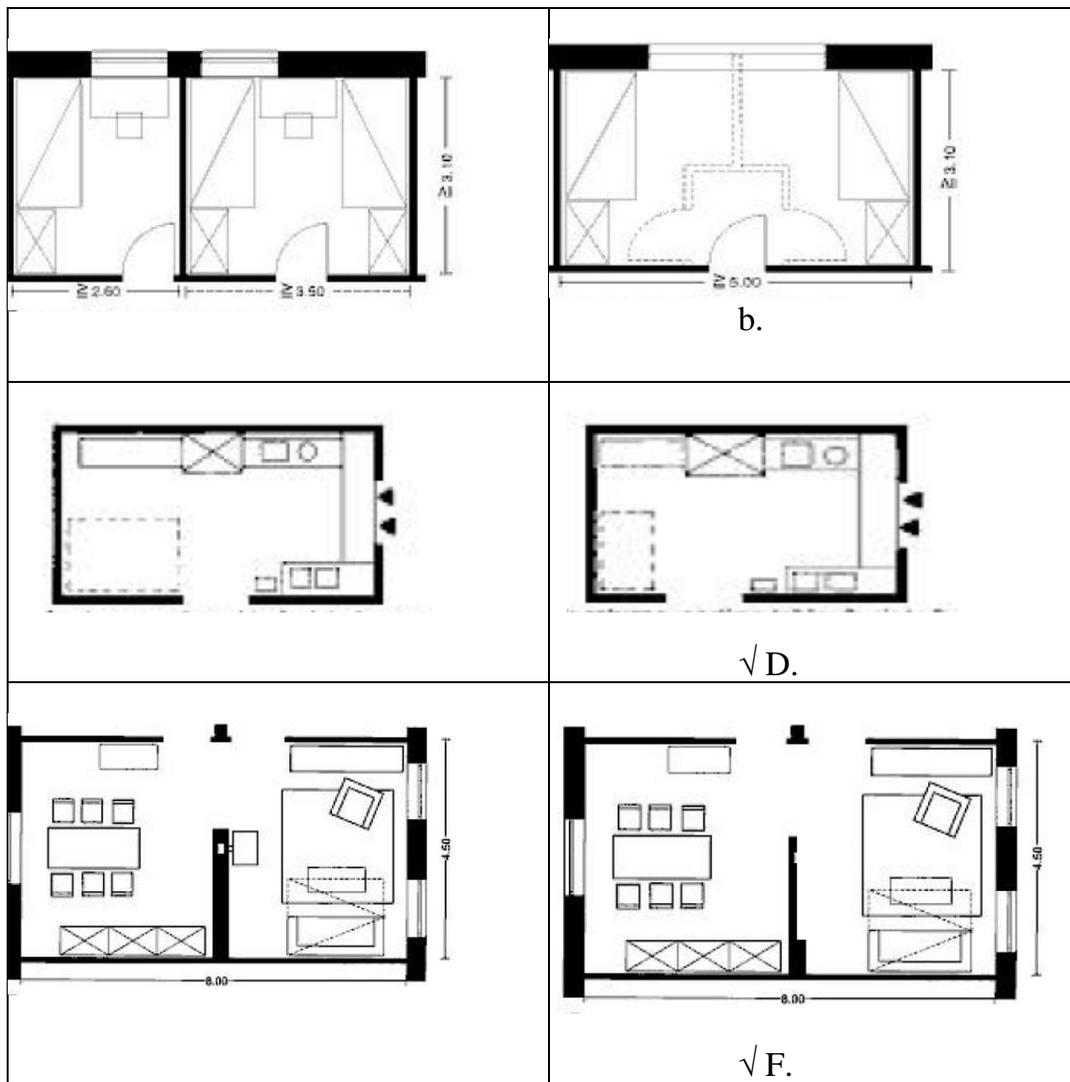
Figure 3.11. Shows some positive arrangement in designing the interior space

Figure 11 shows some positive arrangements in designing the interior space could be useful during COVID-19, when comparing between a and b, we found that b is more comfortable because it provides more space for more activities in the bedroom. Also, when comparing

between (c) and (d); we found that (d) is more positive than (c), because when we use small table in the kitchen it provides more space for working. In addition, when comparing between (e) and (f), we found that (f) is more comfortable in the living room than (e) because it provides more space for more activities. In addition, opening the windows for cross ventilation twice during the day it is very important to refresh the air.

The conclusion: humans are adjusting to the circumstances. At the beginning of the lockdown in Saudi Arabia, the government did not allow people to go outside, except for at specific times (curfew), such as to the market or pharmacy, from February to April 2020. People were performing their jobs and sports activities from home and participating in online meetings or webinars. After three months, the government allowed people to walk around in their neighborhood. Daily natural ventilation for one hour in the morning and the afternoon was necessary to change the oxygen inside homes. Additionally, well-being could be increased by maximizing spaces and adding plants. Figure 1 shows the management of interior spaces during the COVID-19 pandemic.

3.5.2 Visiting the Park

Regarding hypothesis 2*: COVID-19 is affecting the design of outdoor spaces*

COVID-19 affecting our safety and health, (Freeman, Sh., 2020) discussed COVID-19 and outdoor safety in-depth, highlighting solutions such as reducing the number of people entering public parks, staying 2 m away from others, limiting the access to activities, managing the outdoor space, and introducing mental health agencies to deal with COVID-19-related stress. We agree with all these points, and we encourage checkpoints at park entrances to check the safety procedures and to encourage people to walk and practice activities in the park. (Clouston, S. A., 2021). This study suggested that outdoor transmission of COVID-19 may occur, noting that the risk of transmission of COVID-19 in the summer was highest on days when the wind was reduced. Our findings agree with this result, and we encourage the use of computer programs to study environmental issues. Another study applied ENVI-MET software to study the environmental issues and the solar effects on the surrounding buildings, reporting an increase in the temperature of the building's roof and the facing elevations, suggesting a green buffer zone between buildings and parks, especially high trees. (Freeman, Sh., 2020) and (Lannoy, L. d., 2020) discussed the importance of outdoor space for children and youth, with outdoor play being important for children's physical and mental health; therefore, provincial policies related to COVID-19 and outdoor play are required. We agree with this result. Also, our study of the Al Rouda park, as an example of an outdoor environment, provides a play yard for children and youth, this research is concentrating on the duration time, how many times you visit the park (Figure 8).

(Xie J., Luo S., Furuya K., & Sun D., 2020) and Barbarossa (Barbarossa L., 2020) discussed the importance of transportation during the COVID-19 pandemic in Italy to make up for lost time and to start a green revolution that is aimed at quickly decarbonizing urban transport and enhancing cycling and walking throughout the city. We agree with this result, as few people were using bicycles, highlighting the importance of walkability and riding bicycles instead of using public transportation to reduce the spread of the pandemic.

Honey noted the importance of using public space for recovery during the pandemic, and that cities will be shaped because of applying social distancing (Bravo, L. & Tieben, H. editors, 2020). Our findings agree with this result, and we encourage people to practice their activities at home, such as sporting, reading, dancing, painting, watching TV, playing games, and spending time with family. Geng stated that the results for most countries included in their analysis showed that park visitation increased since 16 February 2020 compared with visitor numbers before to the COVID-19 pandemic (Geng, D., Innes, J., & Wu, W., 2021). D'Ascanio stated that it is important to ask whether the COVID-19 pandemic will prompt a shift to healthier cities that focus on well-being rather than function and economic aspects (D'Ascanio, R. & Mondelli, F P. editors, 2021). We agree with this

researcher regarding this study's focus on health factors in five areas: interior spaces, outdoor spaces, shopping malls, mosques, and psychological effects.

COVID-19 affecting our routine in visiting the park, the research found that most of the respondents reported were never visited the park because they were afraid of contracting SARS-CoV-2. While few reported they visited the park daily. People are encouraged to visit the park and apply the safety procedures. A quarter reported no control point at the park entrances and exits to measure body temperature or check compliance with the health procedures. Figure 8 shows the respondents' responses regarding visiting parks during the COVID-19 pandemic.

3.5.2.1 Case Study sample in an Outdoor Environment (Al Rouda Park) in Riyadh

Al Rouda Park, with an area of about 3200 m^2, is in the middle of Riyadh.
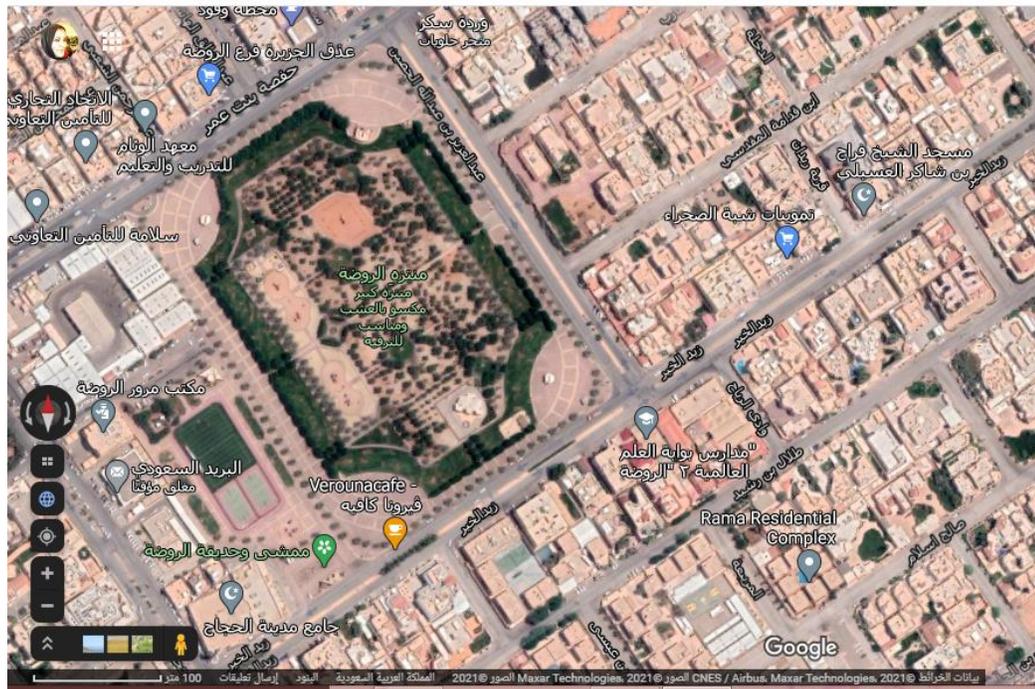
Figure 3.12. Al Rouda park in the middle of Riyadh is the focus sample for studying the outdoor environment (Google Earth)

The park provides several facilities for children, and adolescents. There is a sports area and a play yard for football and volleyball. Besides, there are children's play areas and there are sitting areas in seats or on the grass. The most important activity that attracts most of the visitors is the walkway around the park.

The walkway   Sitting area

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The grass, which is also offered for families

Stand offering snacks and coffee

The play yard for sports

The children's play area

Figure 3.13. Facilities in Al Rouda Park, Riyadh

5.2.2 Environmental Issues

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 m above the ground. The wind experienced at any given location is highly dependent on the local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The hot season in Riyadh lasts for 4.3 months, from 13 May to 23 September, with an average daily high temperature above 25°C to 44°C in July. The cool season lasts for 3.0 months, from 26 November to 26 February, with an average daily high temperature below 22°C to 7°C Figure 38. The coldest day of the year is 11 January.

The average hourly wind speed in Riyadh displays mild seasonal variation over the year. The windier part of the year lasts for 2.9 months, from 22 May to 17 August, with average wind speeds of more than 8.7 m/s per hour. The windiest day of the year is 4 July, with an average hourly wind speed of 10.0 miles per hour. The calmer time of year lasts for 9.1 months, from 17 August to 22 May. The calmest day of the year is 8 October, with an average hourly wind speed of 7.4 m/s per hour.

This section also discusses the total daily incident shortwave solar energy reaching the ground over a wide area, considering seasonal variations in the length of the day, the elevation of the Sun above the horizon, and absorption by clouds and other atmospheric constituents. Shortwave radiation includes visible light and ultraviolet radiation. The average daily incident shortwave solar energy displays significant seasonal variation over the year.

The brighter period of the year lasts for 3.5 months, from 12 May to 30 August, with an average daily incident shortwave energy per square meter above 7.4 kWh. The brightest day of the year is 21 June, with an average of 8.3 kWh. The darker period of the year lasts for 2.8 months, from 9 November to 2 February, with an average daily incident shortwave energy per square meter below 5.0 kWh. The darkest day of the year is 10 December, with an average of 4.2 kWh. We based the humidity comfort level on the dew point because it determines whether perspiration evaporates from the skin, thereby cooling the body. Lower

dew points feel drier, and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, the dew point tends to change more slowly; thus, although the temperature may drop at night, a muggy day is typically followed by a muggy night. The perceived humidity level in Riyadh, as measured by the percentage of time in which the humidity comfort level is muggy, oppressive, or miserable, does not vary significantly over the year , remaining virtually constant at 0% throughout the year, i.e., the climate is hot and dry most of the year. Weatherspark (Park, Weather, 2021)

In both summer and winter, people visit parks near their houses. Al Rouda Park is well-designed to encourage daily visitors. The most suitable time for walking, especially during the COVID-19 pandemic, is from 6:00 to 8:00 a.m. and from 4:00 to 6:00 p.m. There are no crowds at these two times. There are no checkpoints to measure personal temperature.
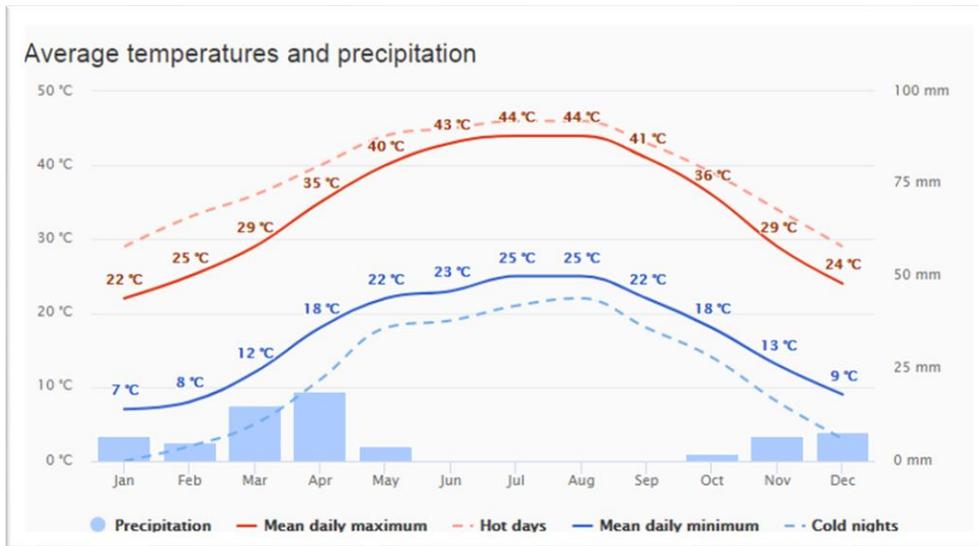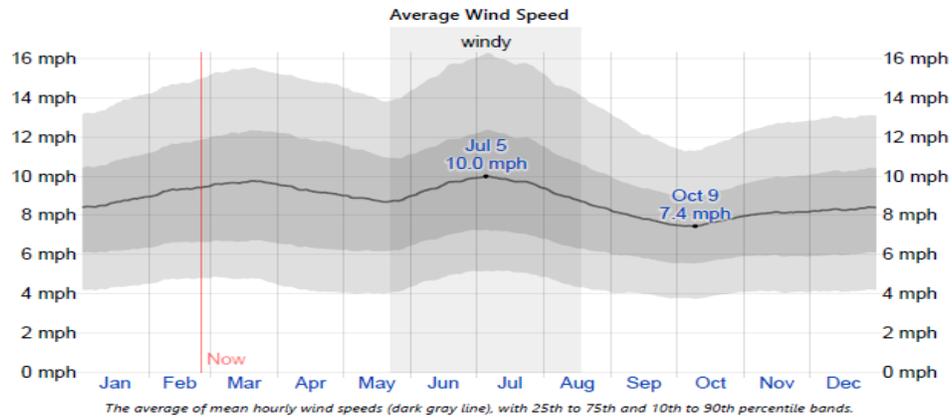
Figure 3.14. Annual weather variations in Riyadh. Source: Weatherspark (Park, Weather, 2021)

3.5.2.3 Simulation by Using ENVI-MET

Using a simulation program, the thermal image of the park was studied, with wind direction, and temperature at the microscale. For example, ENVI-MET software is a program used in the design phase that helps to reduce the urban heat surrounding the park by adding more trees and water features.
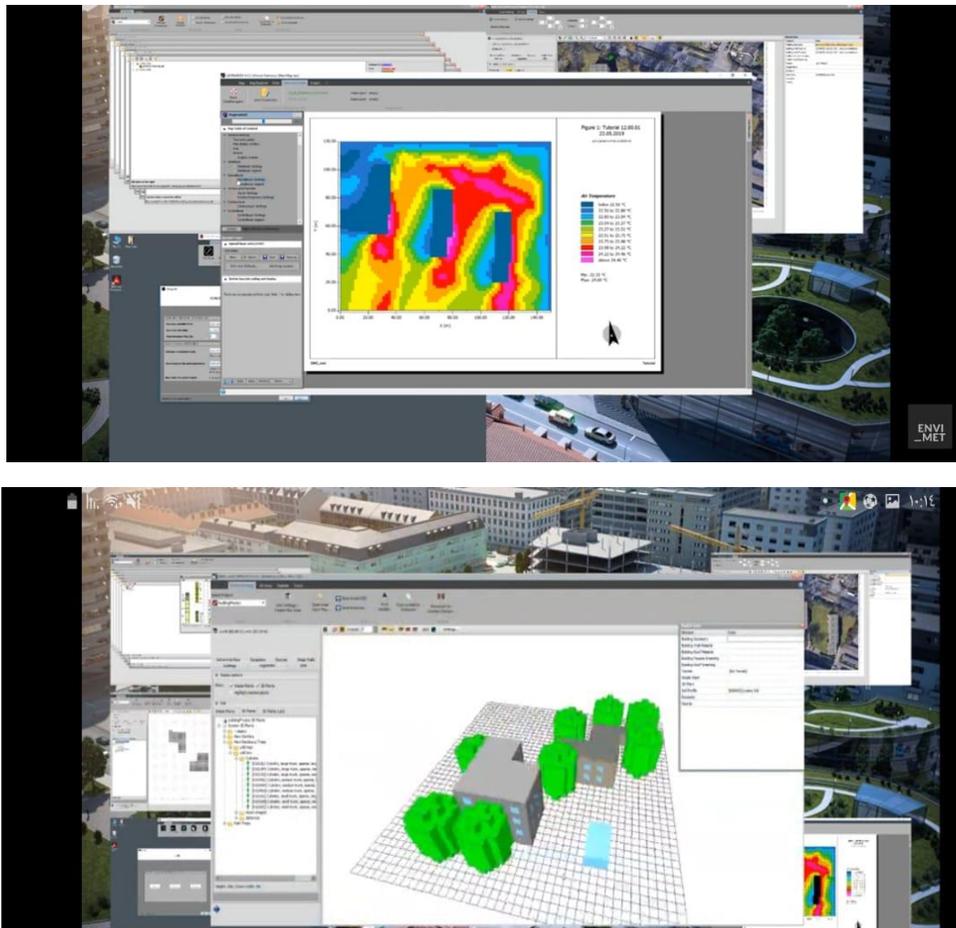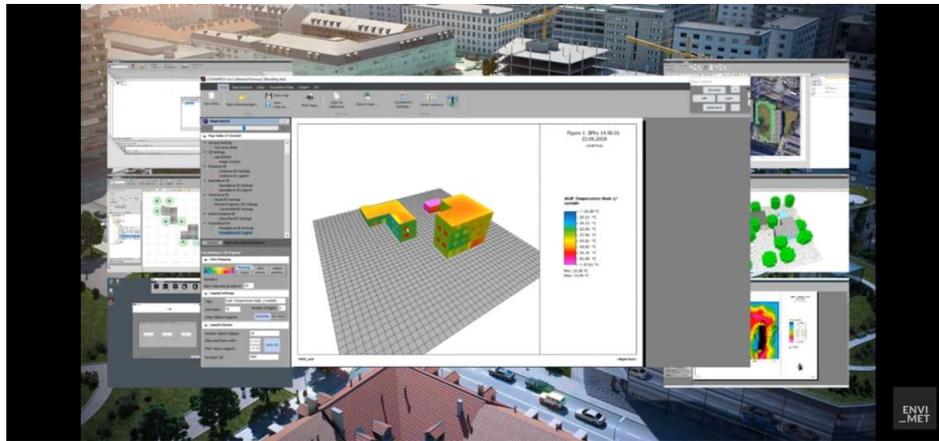
Figure 3.15. ENVI_MET (ENVI-MET, 2021) software program analyzing environmental issues

ENVI-MET software was used to study the environmental issues in the park, such as temperature, humidity, wind direction, and solar radiation, to identify potential solutions for exceeded temperature especially in summer such as planting tall trees to create a buffer zone between the buildings and the park to reduce the temperature.

The solar radiation in Figure 15 presented in red is the highest temperature (22 to 25°C) between the block buildings, the orange indicates 20 to 21°C; the yellow represents 19°C to 20°C, and green is the lowest temperature, between 15°C and 19°C. The prevailing wind direction is northwest, at 8 mph, and the humidity is 30% in March. It is important to plant high trees as a buffer zone between the park and the surrounding buildings to minimize the temperature, especially in summer.

The recommended health procedures regarding COVID-19 in parks include checkpoints near the main gate and main entrance. Notably, most parks in Riyadh, such as Al Rouda Park, have not had checkpoints during the COVID-19 pandemic.

- The Tawakkalna application was implemented by the government for entrance to all public spaces, which should be downloaded on personal mobile phones and presented at the checkpoint to ensure that a visitor is not infected with the virus (Prevention, C. O., 2020),

- Checkpoints in parks should be provided during the COVID-19 pandemic to ensure the health procedures are being applied, such as checking personal temperatures using smart devices and wearing a mask.

- People, including children and youth, should visit the park weekly for walking and practicing sports, as fresh air is required for their health, especially during COVID-19.

- People should be encouraged to use bicycles within their neighborhoods.

- Software such as ENVI-MET should be used to study environmental issues, such as temperature, humidity, wind direction, and solar radiation to provide solutions for exceeded temperature especially in summer furthermore, tall trees should be planted to create a buffer zone between the buildings and the park to reduce the temperature.

- Outdoor fans should be used in summer to increase the walkability of Riyadh.

- Health procedures should be applied to all park visitors.

- Some effective design solutions should be applied in the park such as, Figure 16 shows some effective solutions in designing the park during COVID-19 by applying the social distancing in the seats (b), Amphitheatre (e), drawing circles in the grass

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for families with social distancing (a), and drawing specific path for walking and running(d). Figure3.16 shows some effective solutions in designing the park.

a. circles on the grass for sitting	b. Social distancing on seats
d. Drawing specific path for walking and running	e. Social distancing in the amphitheater
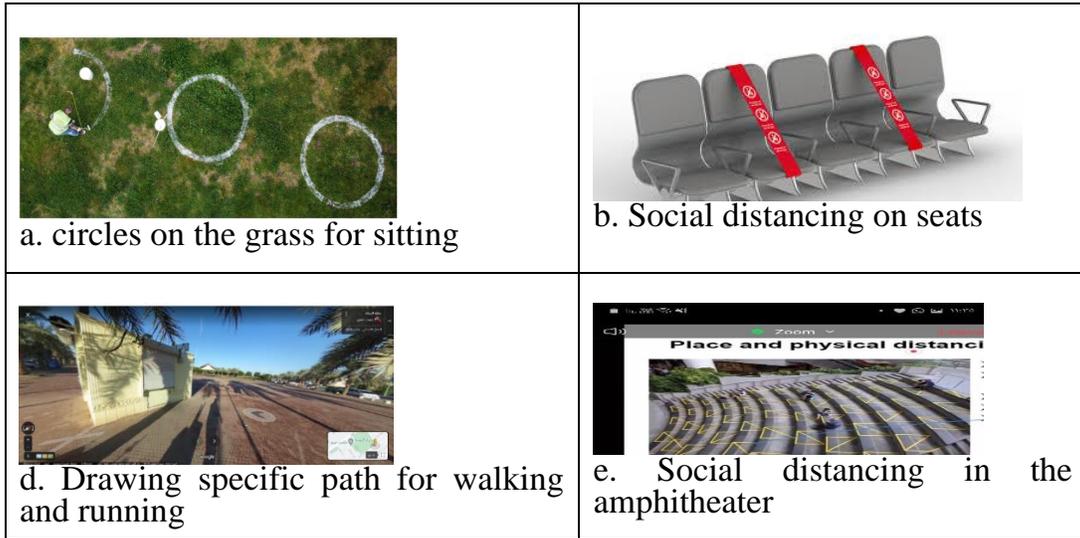
Figure 3.16. Shows some effective solutions in designing the park post-COVID-19

3.5.3 Mosques

Regarding hypothesis 3*: COVID-19 is affecting praying in mosques.

COVID-19 affected visiting the mosque, more than half of the respondents reported they never visited the mosque because they were afraid of contracting COVID-19.

Other's respondents reported visiting the mosque once per week, some visited the mosque twice per week, others visited the mosque three times per week, and a few visited the mosque daily. Table 2 shows the duration time of the respondents visiting the mosque, few people visited the mosque every day or per week, and this mean that COVID-19 strict people to practice their everyday activities.

Table 3.2. Shows the duration time of the respondents visiting the mosque

Duration time/week	Once a week	Twice a week	Three times a week	Every week	Never go	Others
Number of visitors	12	11	5	20	84	6

Respondents reported that health procedures were applied in the mosques, such as the measurement of temperature, providing sanitizer, and wearing masks. Few of respondents reported not attending because they were under 12 years old.

Thus, health procedures were being applied in the mosque and, figure 7 shows that most of the respondents said that social distancing was applied in the mosques, Figure 3.17 shows the social distancing between the prayers about 2 m as distance. Each prayer brings his own Sigada. Also, the total number of visitors is decreased per hour. The public awareness of the health procedures has increased.

Figure 3.17. Shows the social distancing between prayers about 2 m in the mosques

5.4 shopping malls

Regarding *hypothesis 4:* COVID-19 is affecting visiting shopping malls.

COVID-19 affected visiting the **shopping mall**, half of the respondents agreed that they did not visit shopping malls because they were afraid of COVID-19 affecting our daily rotine, most respondents reported visiting the shopping mall once per week, other respondents said that they did not visit the shopping mall (Table 3) because of financial issues, a few answered that they lost their job, while others reported that prices had increased. For the health procedures. Most of the respondents reported sanitizer being placed near the front door of the shopping mall. Most of the respondents reported that social distancing were applied in the shopping malls. Also, respondents reported measurements of body temperature by a smart meter at the front door were applied, and few of the respondents reported that their temperature was not measured at the front door. Figure 6 shows the results of the respondents for the shopping mall questions:COVID-19 affecing our safety and health. Table 3 Shows the duration time of the respondents visiting the shopping mall, the results show that zero vistors the shopping mall everyday, and most of the respondents visted the shopping mall once per week, this mean that COVID-19 stric people to practice their everydayactivities.

Table 3.3. Shows the duration time of the respondents visiting the shopping mall

Duration time/week	Once a week	Twice a week	Three times a week	Every day	Never go	Others
Number of visitors	78	11	4	0	36	6

Figure 3.4, photo (a) shows the social distancing is applied in shopping malls, also most of shopping malls design reception room to apply the health procedures such as testing the temperature by smart device and wearing the mask. In addition, the numbers of visitors are decreased per day.

5.5 Psychological Effects

Regarding *hypothesis 5:* COVID-19 has psychological effects on people.

COVID-19 affected our health, more than half of the respondents said that they were affected by COVID-19. COVID-19 affected our family functions and relations they described their family as functioning much better, few said that their family functioned much worse during their infection, and few reported no difference in their family's functioning. Others reported that their family provided support for them, and more than half said the family support was a little better. Also, they reported that they were in a good mood, others of the respondents stated that the family support was no more than usual, and

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others reported that the family supported them as much as they usually did and had average feelings. More than half were not losing confidence and few reported average feelings.

COVID-19 has psychological effect, more than half of the respondents reported that they did not visit parks, shopping malls, or the mosque because they were afraid of COVID-19.

COVID-19 affected our daily activities, the last question in this part was about engaging in hobbies at home during and after the lockdown. Of the respondents, more than quarter started reading, walking, or dancing; others used social media more than usual; a few took part in sports. Also, they listened to the news on the television about the COVID-19 pandemic, others reported watching movies on television, a few of the respondents said they published scientific research, and few published books.

Notably, a few reported riding bicycles. This finding has two meanings: riding bicycles is uncommon in Saudi Arabia and that people spent most of their time at home.

The respondents said that they participated in webinars, taught online, and/or were playing video games, and a few were visiting neighbors. Thus, people rarely visited each other during the COVID-19 pandemic.

Figure 3.10 shows the results of how people spent their time during the COVID-19 pandemic. They were practicing their hobbies, such as reading, sporting, walking, and writing.

When comparing the results for the five areas, more than half of the respondents reported that they were not visiting these areas because they were afraid of contracting COVID-19. Although the survey was distributed twice, in April 2020 and in March 2021, despite one year passing, the results were still the same: more than half were still afraid of contracting COVID-19. Here, we studied the psychological effects of COVID-19 on people, and it found that it has deeply affected people it constrains them to come back to their social life, most of the respondents reported that because they were afraid of being affected by the COVID-19. We encourage people to practice their hobbies in the interior space and exterior space.

The last question on the survey was an open question. People wrote their opinions on the effects of the COVID-19 pandemic on social life. One respondent said: "May God keep the epidemic from us, and may God heal their patients, and have mercy on their dead ... Oh God, Amen." Others responded as noted in Figure 18.

First, I think covid-19 changed a lot of things in our life during the quarantine or also now after the quarantine, so now you can do your hobbies normally as before, but you must be careful.

Keep yourself

I scared from death

Nothing

I think the COVID-19. Will disappear soon and our life will be better. Thanks

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Figure 3.18. Some responses of the survey respondents to the open question. How did you spend your time at home during the COVID-19 lockdown

3.5.6 Occupational Aspects

Regarding hypothesis 6: COVID-19 has affected the **occupational** aspect.

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Fifty percent of the respondents reported that they were practicing teaching online post covid-19.

While about quarter they were practicing online webinars, also, few were publishing books and others publishing scientific papers, and less than quarter were practice the online webinars. When asking the respondents, why you did not visit the shopping mall? Few of the respondents reported *'Because I lose my job'*, other reported *'I have no money'*.

COVID-19 affected the work condition for example schools and universities. During the lockdown in April to May 2020, Saudi Arabia applied e-learning in schools and universities as a special situation. Now we come back to universities and applied the blending learning from September to April 2021. This highlights the importance of applying training program to teachers to face these challenges in the accessibility, new teaching strategies in the online teaching and learning, Quality Matter principles, improvement of the Student Management system (LMS).

COVID-19 has deep psychological effect on people, half of the respondents reported they were never visiting the shopping mall, the mosques, and the park because they were afraid from covid-19, they should practice positive activities while they are staying home.

COVID-19 has deep impact on the workplace, in safety and health procedures such as social distancing, wearing the mask, measuring the temperature by smart devices. Table 3.4 shows the effect of COVID-19 on occupational aspect and the best practice.

Table 3.4. The effect of COVID-19 on occupational aspect and the best practice

The effect of COVID-19 in occupational aspect	The best practice
COVID-19 affect our health	Apply the health procedures, such as wearing the mask, measure the temperature by smart device
	Apply software to check your health situation like
	Tawakkalna
COVID-19 affect our workplace	Going into online teaching and learning, online marketing
COVID-19 affected our employment	Searching about other online opportunity such as online teaching, online marketing, conference moderator.
COVID-19 affected our daily routine	Practice daily activities at home such as
	Sporting, writing, attending webinars, attending conferences, practice your hopies

Table 3.5. The results for the five focus areas: interior space, exterior space, mosques, mall, psychological effects, as well as the three focus questions about the duration, health procedures, psychological effects in March 2021

Duration					Health Procedures					Psychological Effect		
Once per Week	Twice per Week	Three Times per Week	Every Day	Never	There is no Social Distancing	There is no Temperature Check (%)	There is no Sanitizer (%)	Everyone is Wearing Mask (%)	No Control Points (%)	I am Young (Under 12 Years Old) (%)	I am Afraid of the Corona virus	

	Yes (%)	No (%)	Maximize the Space (%)		Plants (%)	Open a Window (%)						
Managing interior spaces	83	17	24.8		18.4	33.3	-	-	-	-	-	
Visiting parks	29	4.2	7.8	7.8	44	12	0	0	14	25	0	50
Visiting mosques	8.3	7.8	3.5	14	59	80	80	71	68	-	5.6	59
Visiting shopping malls	55	7.8	2.8	0	25	105	128	128	-	-	-	50
Psychological effects	30 Reading	33 Walking	14.8 Dancing	43 Social media	18.4 Sports	13 TV	43 Movies	22 Publishing	7 Riding a bicycle	16 Webinar	27 Video games	-

Notable recommendations include:

- People should continue participating in activities and planning for their family and children's future.
- People should be encouraged to apply health procedures when visiting shopping malls: social distancing, using sanitizer and wearing a mask.
- People are encouraged to go outside, visit parks, and practice walking and sports while applying the health procedures.
- Additionally, this research encourages people to visit mosques or churches regularly and to apply health procedures.
- We also recommend that people think positively and manage their time at home by practicing sports, reading, writing, managing their indoor spaces by opening the windows twice per day for good ventilation, adding plants, and working at home.
- People should continue to learn the new technologies in e-learning, accessibility.

Future Resources

Future research is recommended in these three areas because of the lack of studies identified in the concerned literature:

1) The effect of COVID-19 on Economics.
2) The psychological effect of COVID-19 on children and students.

3.6. Conclusions

This study was conducted during the post-covid-19 period in Riyadh, Saudi Arabia, to study the effect of COVID-19 on academic social life. Six focus areas were studied: shopping malls, mosques, interior spaces, exterior spaces, and the psychological effects of the COVID-19 pandemic on occupation aspect. Mosques were applying health procedures by testing temperatures near the entrance doors and applying social distancing measures, and mask-wearing was practiced by most visitors. Most respondents reported changing their interior spaces to fit their everyday activities. The research encourages people to visit the park every day, shopping mall weekly, the government should apply social distancing in seats and grass, control point to check the health procedures by smart devices, the respondents said that to increase their well-being, they practiced activities at home, listening to the news about COVID-19 on television, playing video games. Notably, the

respondents rarely visited each other during the pandemic. Regarding the occupation aspect people should keep learning new skills to fulfill the new Challenges by COVID-19. We believe that much research could be done in COVID-19 in the future.

Acknowledgement

References

Abid H., & R. V. (2020). *Effects of COVID 19 Pandemic in Daily Life*. Current Medicine Research, and Practice.

Alkhamees1, A. A. (2020). The Psychological Impact of COVID-19 Pandemic on the Students of Saudi. *The Open Public Health Journal, 14*, 12-23. https://doi.org/10.2174/1874944502114010012

Al-Serf, M. (2020). *How Can IOT Support Sustainability in Mena*. Riyadh City, 00966, Saudi Arabia. Retrieved from https://youtu.be/xSaUytTmN0U

Al-Serf, M. (2020). *Implementation of Green Building in Saudi Arabia*. Riyadh City. Retrieved from https://youtu.be/FpZjVkSgJO8

Authority, P. H. (2021). *Mosques Protocole*. Retrieved from https://covid19.cdc.gov.sa/professionals-health-workers/preventive-protocols-from-29-10-1441/mosque-protocols-en/

Awaji, M. A. (2020). Pandemic of Coronavirus (COVID-19) in Saudi Arabia. *Prepints*. https://doi.org/10.20944/preprints202007.0549.v1

Barbarossa L. (2020). The Post Pandemic City: Challenges and Opportunities for a Non-Motorized Urban Environment. An Overview of Italian Cases. *Sustainability, 12*(17), 7172. https://doi.org/10.3390/su12177172

Batty, M. (2020). The Coronavirus crisis: What will the post-pandemic city look like? *Environment and Planning B: Urban Analytics and City Science, 47*(4), 547-552. https://doi.org/10.1177/2399808320926912

Blue -Nile. (2020). *The Psychotically Effect of COVID-19.* (Mohamed Osman, Interviewer). Retrieved from https://youtu.be/g4gZ3u2oN0c

Bravo, L., & Tieben, H. editors. (2020). *A yeas without public space under the Covid-19 pandemic, initiative by City Space Architecture and The Chinese University of Hong Kong, School of Architecture*. Retrieved from https://www.journalpublicspace.org/index.php/jps/navigationMenu/view/covid-19

Broudehoux, Anne-Marie. (2021). *Post-pandemic cities can permanently reclaim public spaces as gathering places as gatheringplaces*. Retrieved from https://theconversation.com/post-pandemic-cities-can-permanently-reclaim-public-spaces-as-gathering-places-150729

Clouston, S. A. (2021). Outdoor transmission of COVID-19: Analysis of windspeed. *medRxiv preprint*. https://doi.org/10.1101/2021.02.05.21251179

Corvacho, Helena. (2020). *Thermal comfort in public space and sustainability. 3rd International Exergy, Life Cycle Assessment, and Sustainability Workshop*. NISYROS - GREECE: University of Porto. Retrieved from https://www.researchgate.net/publication/337911379

D'Ascanio, R., & Mondelli, F P. editors. (2021). *KM0 - Displaying Perceptions of Quarantine Landscape, online UNISCAPE Landscape Atelier - Cultivating*

Innovative Visions. Retrieved from https://www.uniscape.eu/km0-displaying-perceptions-of-quarantine-landscape%e2%80%a8/

Echegaray, F. (2020). *Anticipating the post-covid-19 world: implications for sustainable lifestyles.* https://doi.org/10.2139/ssrn.3637035

ENVI-MET. (2021). *ENVI-MET Software Program.* Retrieved from https://www.envi-met.com

Freeman, Sh. (2020). *COVID-19 and outdoor safety: Considerations for use of outdoor recreational. Canada: National Collaborating Centre for Environmental Health.* Retrieved from https://ncceh.ca/documents/guide/covid-19-and-outdoor-safety-considerations-use-outdoor-recreational-spaces

Geng, D., Innes, J., & Wu, W et al. (2021). Impacts of COVID-19 pandemic on urban park visitation: a global analysis. *J. For. Res., 32*, 553-567. https://doi.org/10.1007/s11676-020-01249-w

Gruenwald, H. (2021). *Covid-19 and Information Technology.* USA: Researchgate.

Hamidi, S., Sabouri, S., & Ewing, R. (2020). Does Density Aggravate the Covid-19 Pandemic? *Journal of the American Planning Association, 86*(4), 495-509. https://doi.org/10.1080/01944363.2020.1777891

Health, M. (2021). *Mosque Protocoles.* Retrieved from https://covid19awareness.sa/en/archives/10242

Honey, J. (2021). *Public Spaces and Health in Post-Pandemic Cities.* Retrieved from https://www.isglobal.org/en/healthisglobal/-/custom-blog-portlet/los-espacios-publicos-y-la-salud-en-la-ciudad-pospandemia/8000927/12302

Jaing, S. (2021). Teachers' Voices on the Impact of COVID-19 on School Education: Are EdTech Companies Really the Panacea? *Contemporary Education Dialogue, 18*(1), 58-89. https://doi.org/10.1177/0973184920976433

Jalal, O. M. (2020). *Impact of Evolving Building Morphology on Thermal Comfort in Public Spaces in Hot Arid Climate.* Riyadh City, Kingdom of Saudi Arabia. Retrieved from https://amakenplacemaking.org/2020/07/25/coffee8-thermal-comfort-in-public-spaces-by-omar-galal/

Qian, M., & Jiang, J. (2020). COVID-19, and social distancing. *Journal of Public Health.* https://doi.org/10.1007/s10389-020-01321-z

Khogali, H. (2020). The Effect of COVID-19 Corona Virus on Sustainable Teaching and Learning in Architecture Engineering. *Modern Applied Science, 14*(8). https://doi.org/10.5539/mas.v14n8p44

Kukenkov, V. (2020). Ergonomics and organization of interior space. *Ergodesign*, 38-41.

Lachlan, L. (2020). *ADVANCING QUALITY TEACHING FOR ALL SCHOOLS Examining the Impact of COVID-19 on the Teaching Workforce.* USA: The American Institute for Research.

de Lannoy, L., Rhodes, R. E., & Moore, S. A. et al. (2020). Regional differences in access to the outdoors and outdoor play of Canadian children and youth during the COVID-19 outbreak. *Canadian journal of public health, 111*(6), 988-994. https://doi.org/10.17269/s41997-020-00412-4

Mark, Th. (2021). *The Kingdom's Response to the COVID-19 Outbreak: Steps That Have Been Taken to Date, King Faisal Center for Research, and Islamic Studies.* Saudi Arabia. Retrieved from https://kfcris.com/en/view/17

Mark, Themson. (2021). *The Effect of CORONA on Teaching and Students in Saudi Arabia, King Faisal Center fore Research and Islamic Studies.* Saudi Arabia. Retrieved from https://kfcris.com/en/view/17

Minor, M. T. (2018). *Community*. Retrieved from https://thriveglobal.com/stories/definition-of-social-life-what-it-is-meaning-and-concept/

NEERAJ MISHRA. (2020). *Occupational Therapy Intervention in COVID 19*. India: Occupational Therapy and COVID19 pandemic information & resources.

News, A. (2021). *Shopping Mall*. Retrieved from https://www.arabnews.com/node/1666996/saudi-arabia

Park, Weather. (2021). *Average Weather in Riyadh*. Retrivied from https://weatherspark.com/y/104018/Average-Weather-in-Riyadh-Saudi-Arabia-Year-Round

Prevention, C. O. (2020). *Coronavirus Disease 2019 (COVID-19)*. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/symptoms-

Sameh, S. (2020). *Creating Resilient Cities-Jeddah Post COVID-19*. Jeddah, Kindom of Saudi Arabia, Saudi Arabia. Retrieved from https://youtube.comlclArchiNet

Sameh, S. (2020). *The Influence of COVID-19, and QUARANTINE on our Lifestyle, and Home Design*. Jedda, Kingdom of Saudi Arabia, Saudi Arabia. Retrieved from https://youtube.comlclArchiNet

Scott, J. (May 2020). *What risks does COVID-19 pose to society in the long-term?* Zurich: Zurich Insurance Group. Retrieved from https://www.weforum.org/agenda/2020/05/what-risks-does-covid-19-pose-to-society-in-the-long-term/

Solution, E. D. (2020). *Post COVID-19 Design Solutions*. New Delhi: Environmental Design Solution Limited. Retrieved from https://economictimes.indiatimes.com/company/environmental-design-solutions-private-limited/U74200DL2009PTC189602

Sultan, F. A. (2021). Health and Local Comunity Response to COVID-19 in Saudi Arabia. *Journal of Health and Allied science*.

Tawakkalna. (2021). *Tawakkalna Software*. Retrieved from https://play.google.com/store/apps/details?id=sa.gov.nic.tawakkalna&hl=ar&gl=US

Webster, M. (2020). *Social Life*. Retrieved from https://www.merriam-webster.com/dictionary/social%20life

WHO. (2020). *COVID-19 Small Public Gethering*. Retrieved from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-small-public-gatherings-and-covid-19

Xie, J., Luo, S., Furuya, K., & Sun, D. (2020). Urban Parks as Green Buffers During the COVID-19 Pandemic. *Sustainability, 12*(17), 6751. https://doi.org/10.3390/su12176751

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CHAPTER FOUR

Saudi Vision 2030: Applying a Sustainable Smart Techno-cultural Assessment method to Evaluate Museums' performance post-COVID-19

Saudi Vision 2030: Applying a Sustainable Smart Techno-cultural Assessment method to Evaluate Museums' performance post-COVID-19

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Abstract. UNESCO has defined world cultural heritage as either tangible or intangible cultural heritage. Saudi Vision 2030 strategies is the Culture of Community and Dynamic Supportive Environment, which supports the national identity, maintains the museums, and encourages tourism. This research aimed to assess museums' performance in four focus areas (sustainability, smart solutions, techno-cultural solutions, and health procedures) during the post-COVID-19 period in Riyadh city. The method consisted of a survey distributed during 04/2021 to stakeholders at Dar Al Uloom University in two sample case studies: Al Masmak Fort Museum and Riyadh National Museum. The main research aspects of the two samples were compared. The results: sustainable access (31%) material (34%) water efficiency (20%) energy efficiency (32%) smart solutions (31%) and techno-cultural solutions (34%). The health procedures (56%). The improvement will be reflected in more advanced and innovative solutions for the museum buildings. could be applied to museum buildings locally and internationally.

4.1 Introduction

Internationally, only 30% of all museums have opened after the lockdown; therefore, 70% of museums all over the world are still closed. In Saudi Arabia, only the administrative staff are working, and most of these museums are now under maintenance and remain closed, even after the lockdown was removed in 2020.
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Research questions:

The research was conducted to answer these questions:

1. Are museums open during COVID-19?

2. Are health procedures applied in these museums?

3. Are there evaluation criteria for the museum building regarding maintenance, durability, sustainability, and smart techno-culture?

4. What is the future vision for the museums?

Research Objectives

1. To introduce an assessment method to evaluate the museum buildings post-COVID-19.
2. To find solutions in applying health procedures in the museum buildings.
3. To apply sustainable, smart, techno-cultural solutions in heritage buildings suitable to the post-COVID-19 era and the future.
4. To find a future vision for the museums.

4.2. Literature review

Definition of Heritage culture

The term cultural heritage encompasses several main categories of heritage that are defined by UNESCO [1]. These are: cultural heritage, tangible cultural heritage, movable cultural heritage (paintings, sculptures, coins, manuscripts), immovable cultural heritage (monuments, archaeological sites, etc.), underwater cultural heritage (shipwrecks, underwater ruins, and cities), and intangible cultural heritage (oral traditions, performing arts, and rituals).

Saudi Vision 2030 in heritage

One of the Saudi Vision 2030 strategies is the Culture of Community and Dynamic Supportive Environment, which supports the national identity, maintains the heritage sites,

and encourages tourism. This calls our attention to the importance of preserving our heritage buildings and reusing them as museums and tourist sites.

Sustainability in Heritage buildings

Sustainability in heritage applies three principles: energy, water, and materials. Smart solutions, health procedures, redesigning the interior, and managing the building envelope will be addressed in the Methods section. In addition, [2] discussed sustainability in heritage buildings.

Energy

[3] introduced an energy efficiency study in heritage housing buildings through a rigorous double-coded, thematic analysis of 59 in-depth, semi-structured interviews (totaling 206,771 words) carried out in Greece, Mexico, and the UK. The thematic analysis was combined with dynamic systems analysis, essential for identifying which parameters affect inhabitants'

decisions over time. Additionally, [4] discussed how the life cycle (LC) model was implemented to assess different energy efficiency measures: roof, exterior wall and floor thermal insulation, window replacement, and two different heating systems with thermal dynamic simulation. The results showed that optimal life cycle environmental performance is obtained for insulation thicknesses lower than 80 mm; the study ignored other solutions that could affect energy efficiency, such as thermal insulation. In addition, [5] and [6] discussed the energy in heritage buildings.

Water

It is very important to bring sustainable water solutions to heritage buildings. [7] discussed in her book how we can bring sustainable water solutions to heritage sites, especially in the landscape, through terraces, canals, dams, and wells. There are other solutions such as recycling gray water and using smart devices in toilets.

Material

[8] discussed building life cycle and the assessment of historic buildings through a 1930 building with new construction added in 1960. The results underlined the significance of the emissions from materials in the refurbishment process and how residents play a critical part in realizing the expected energy savings. It was concluded that material uses, and user behaviour have a crucial impact on greenhouse gas emissions from a life cycle perspective.

Smart solutions in public health

[9] discussed the smart maintenance of heritage buildings and focused on energy efficiency, water efficiency, building material, and data collection. A smart database on one drive allows easy control of the building [10] discussed in his MSc. research the importance of using the thermal image in studying the building envelope because it shows the thermal bridge, damaged insulation, moisture damage, air and water leakages. In addition, [11] discussed solutions that could be applied in smart buildings: presence sensors for real-time usage, desk sensors for actual usage, and comfort sensors for CO_2, temperature, and humidity.

Techno-culture

[12] discussed how we can apply cultural values in the museums in India by teaching the children to draw; their drawings were presented in an exhibition about COVID-19. [13] discussed activating the platform in museums and applying digital technologies. [14] encouraged the private sector to fund the museums during the COVID-19 pandemic.[15] discussed social culture and economic factors in museums.

Health procedures

[16] , [17] announced that COVID-19 was a global pandemic, and this has affected our social life, health, and education. [18] and [19] published health procedures that should be applied in public spaces such as museums:
- Mask should be available.
- Sanitizer bottles should be kept in various places.
- Social distancing should be practiced reducing the spread of COVID-19, which has resulted in productivity losses and business disruption and may have a cost impact in the long term, according to [20].
- Vaccination is now required in Saudi Arabia to enter public spaces such as museums.

Redesign the interior space

[16] discussed future trends for interior housing design, and these include building systems in air ventilation, filtration, relative humidity, and temperature in the following:

- Architecture design that redefines the workplace with social distancing of 2 m,
- Improving the design of gathering spaces with plants, water features, social distancing,

- Making use of anti-microbial materials, isolated rooms, flexible rooms, video conference rooms, smart solutions for opening doors and windows. Cleaning the furniture and studying the building envelope through thermal photos.

It is also important to apply safety and health measures at the main entrances and in bathrooms, by providing hand sanitizer and cleaning materials. Additionally, [21] discussed the effect of COVID-19 on interior design spaces, and the study focused on private outdoor spaces, adaptable layouts, WHF functionality, separate entryways, smart systems, multifunctionality.

Align the hypothesis with the literature review of the latest research:

Here we cite reference papers about museums and COVID-19; a limited number of papers were found, with the latest from 2020, early 2021.

From table 1, the researcher will note the need to introduce smart, sustainable, social-cultural, and health impact categories to the post-COVID-19 assessment method. [12] approached the research in social culture by suggesting art therapy, but our research will go further to explain the techno-cultural solutions that could be applied in the museums. [13] approached this research through smart solutions that could be provided online during COVID-19; on the other hand, our research will provide more techno-cultural, sustainable solutions. Although [14] discussed the health factor, this research will discuss in more detail the techno-cultural and online post-COVID-19 smart solutions. [6] discussed the economic factor in funding the museums during the COVID-19 pandemic; this research will discuss the sustainable, smart, and techno-cultural factors post-COVID-19. The museums in Saudi Arabia are not facing financial problems because they are financed by the government. [22] approached the research by suggesting online public services such as lectures, conferences, and forums using digital technologies. [23] approached this research by suggesting teaching and learning in museums, but during COVID-19 this service can only be provided online. Agostino (2020) approached this research by suggesting online social and cultural activities, but these activities need to be developed and sustained into the future. [24] approached this research by suggesting online social and cultural activities. [25] highlighted the idea that museums should transfer to digital exhibitions; our research proposes online activities such as online tours. [26] offered digital culture solutions such as virtual lectures, forums, and tours, along with digital online resources. [27] agreed with this research in providing new technologies to deal with tourism during COVID-19. [28, 29] both agreed in applying the smart solutions within the museums during COVID-19. The researcher notice that no one of these researches wrote about the applying the health procedures in museums during covid-19.

	Energy	Social - Culture	Economic	Cast Assessment	Building Envelope	Sustainable	Smart	Health	Research Output
[12]		✓						X	Culture
[13]							✓	X	Smart digital solutions
[14,6]			✓					X	Economic factor-
[22]			✓					X	Public services
[23, 24]		✓						X	Social culture
[28. 29]							✓	x	Smart solutions
[25, 26]							✓	X	Digital activities
[27]		✓	✓					X	Technologies

Table 1: The relation between the literature review and research output.

4.3. **Methodology**

1. Identifying LEED Sustainable museums requirements as benchmarking and base line in designing the Assessment method, LEED sustainable museum concentrating on the

building process, including the design, the construction, and the stakeholders concentrating in energy, lighting, indoor environmental quality, site, water, material, minimum points should be achieving is 40 points to be certifies [30] and [31] discussed LEED main categories.

2. The research methodology introduces new design assessment method to evaluate museum buildings post-COVID-19 included the following main pillars:

- Sustainable (including site, material, energy, and water) solutions.
- Smart solutions in evaluating the building envelope by thermal imagery.
- Smart solutions in post-COVID-19 and health procedures.
- Techno-cultural solutions in using online platforms, virtual reality, online webinars.

3. Applying the method to two case studies in Riyadh city museums during 20 April 2021 to 20 May 2021, Riyadh National Museum (RNM) and Al Masmak Fort Museum (MFM).

4. Redistribute the survey during 1/09/2021 to 30/09/2021 to increase the response from 25 to 66 respondents

5. Analyze the data for MNM and RNM in the four main pillars.

6. Identifying the weak points and strengths for the future vision of museums

The Research Plan

| The survey analysis | The Results | The Discussion | The Conclusion acknowledgme |
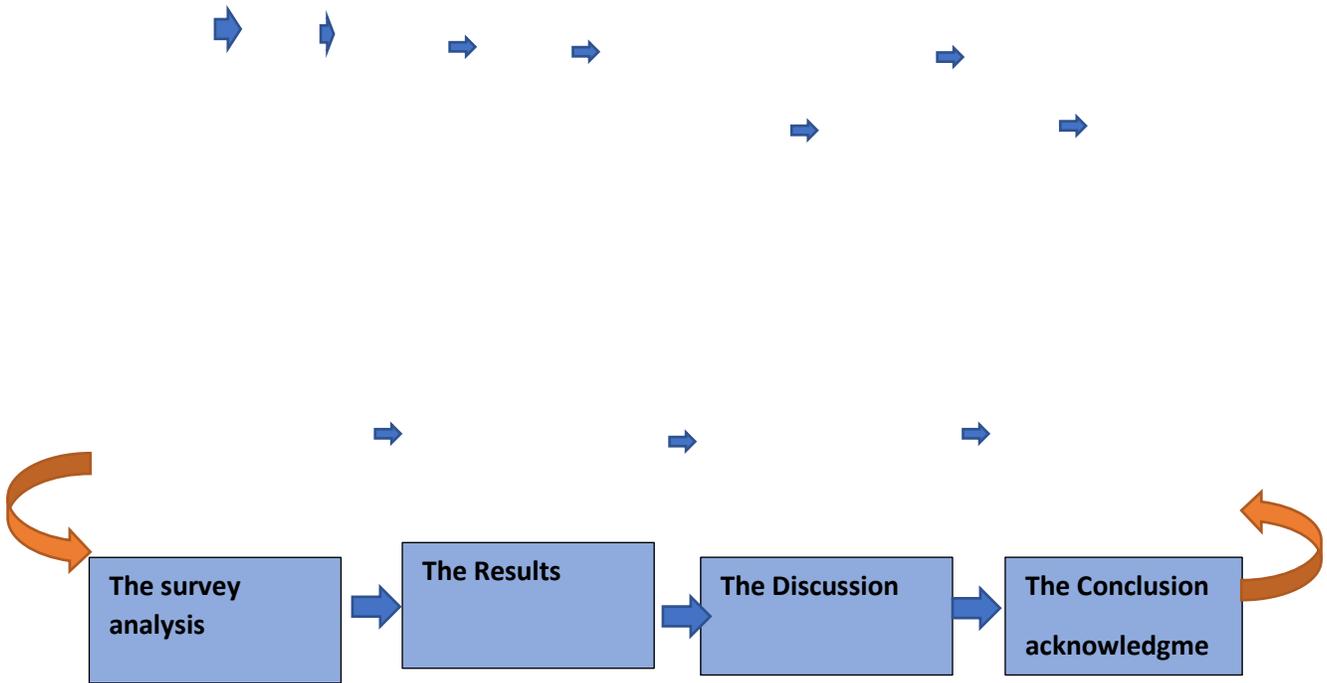
Figure 1: The assessment method to evaluate the museums' performance post-COVID-19.

4.3.1 Design of the Assessment Method

The survey questions

The survey was distributed from 1 April to 1 May 2021 to students, teachers, engineers, visitors, and administrators at Dar Al Uloom University, Al Masmak Fort Museum, and Riyadh National Museum. The sample size was 100 samples, and only 25% of the targets answered the survey. Distribution of the survey was limited by COVID-19. The survey was distributed by the Deanship of Graduate Studies and Research by email to the targets. In addition, it was sent to the administration of both museums.

4.3.2. Applying the method to two sample museums in Riyadh city

4.3.2.1 Riyadh National Museum (RNM)

Introduction

The Riyadh National Museum is the most famous one in the KSA, located in the middle of King Abdul-Aziz Historical Center, which was established as a cultural and civilization center highlighting the prominent history of the Arabian Peninsula and its historical message of disseminating Islam.

Riyadh National Museum (RNM) has multiple historical, archaeological, cultural, and scientific museums. The museum's two-story building covers twenty-eight thousand square meters. The storyline leads visitors from the main reception area to The Man and Universe Hall (Figure 3), Arab Kingdom Hall (Figure 4), Pre-Islamic Era in Jahiliyya Era Hall (Figure 5), The Prophet's Mission Hall (Figure 6), and the displays here use smart screens, artworks, and sound effects (Figures 7 and 8). Islam and the Arabian Peninsula Hall the use 3D modelling (Figure 9); they are followed by the Exhibition Hall of the Kingdom's Unification (Figure 10). To reach the last hall you use the return stairs to the ground floor where you will find Hajj and the Two Holy Mosques Hall (Figure 11), which features a large 3D model.

This museum provides a modern educational environment for different segments of the local community and visitors of all ages and occupations, such as children, families, researchers, specialists, and others.

The RNM used technologies such as an online virtual tour during COVID-19 on their website (Figure 12). Additionally, there is an outdoor plaza used for different cultural activities such as a celebration of the National Day (Figure 13).

Figure 4.2. The main Entrance of Riyadh National Museum (RNM).

Figure 4.3. The Man and Universe Hall.

Figure 4.4. Arab Kingdom.

Figure 4.5. Pre-Islamic Era (Jahiliyya Era Hall)

Figure 4.6. The Prophet's Mission Hall.

Figure 4.7. Smart screen in Prophet Mohamed Hall

Figure 4.8. Art works.

Figure 4.9. Islam and the Arabian Peninsula Hall

Figure 4.10. Exhibition Hall of the Kingdom's Unification.

Figure 4.11. The Hajj and the Two Holy Mosques Hall.

Figure 4.12. Virtual tour on RNM website

Figure 4.13. Recycling water.

3.2.2 Al Masmak Fort Museum (MFM)

Al Masmak Fort Museum was opened to the public during the King Abdul-Aziz period and presents the history of the kingdoms in Riyadh city. The fort was built from 1319, the era of Imam Abdullah bin Faisal bin Turki bin Abdullah bin Mohammed bin Saud, to 1902, the King Abdul-Aziz era. The main entrance and outdoor (Figure 4.14). The storyline starts in the main reception hall (Figure 4.1**5**), then moves to the second hall depicting Riyadh during the period of its seizure (Figures 4.16 and 4.17), Historical Riyad, using LCDL displays (Figure 4.18). The sixth hall, Al Masmak Fort (Figure 4.19), The ninth hall, the courtyard of the water well (Figure 4.20) and MFM National Day celebration in outdoor plaza (Figure 4.21). The museum contains photographs, maps, models, display cabinets, old weapons, traditional and heritage objects, exhibitions, and audio-visual halls. The visitors comprise people from different sectors such as students, teachers, visitors, and tourists (Municipility, 2020)
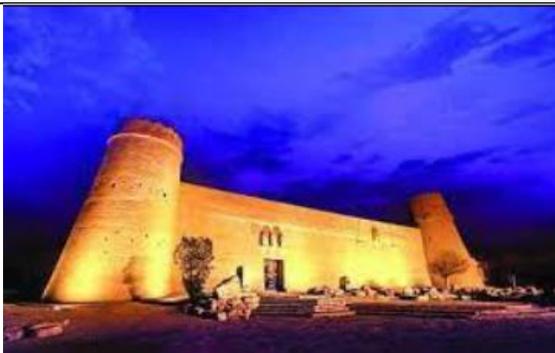
Figure 4.14. Al Masmak Fort Museum (MFM) main entrance.

Figure 4.15. The reception hall.

Figure 4.16. Hall of two Majles.

Figure 4.17. Hall two, Coffe made.

Figure 4.18. Historical Riyad, using LCDL displays.

Figure 4.19. The sixth hall, Al Masmak Fort.

Figure 4.20. The ninth hall, the courtyard of the water well.

Figure 4.21. MFM National Day celebration in outdoor plaza.

3.2.3 The Hypothesis

1. Riyadh National Museum (RNM) and Al Masmak Fort Museum are applying sustainable solutions in accessibility and their sites' energy, water, and materials.
2. RNM and MFM are applying smart solutions.
3. RNM and MFM are applying techno-cultural solutions post-COVID-19.
4. RNM and MFM are applying health procedures post-COVID-19.

5. The Result

A survey was distributed from 20 April to 20 May 2021 to Dar Al Uloom University and the administration staff, and to Riyadh National Museum and Al Masmak Fort Museum to record their responses to the assessment method evaluating the museums' work post-COVID-19. The target sample size was 200. The survey contained 30 questions in 4 focus areas and the results were as follows:

General questions

The focus samples included students, teachers, tourists, administration, engineers, and visitors.

The results showed that the largest percentage of respondents comprised the students visiting the Riyadh National Museum (RNM) and Al Masmak Fort Museum (MFM); (n = 49, 74.2%). The second largest group was the teachers; (n = 7, 10.6%). The third group was administration staff from RNM and MFM (n = 8, 12%). The results showed that there were zero visitors and zero tourists during 2020 and 2021 because of the lockdown.

The second question was about gender. The results showed that there were 36 males and 30 females

The third question was about age. The responses were from 10–20 years (n = 1), 20–30 years (n = 5), 30–40 years (n = 8), 40–50 years (n = 3), and above 50 years (n = 3). The results showed that most of the museum visitors were 30–40 years old.

5.1. Sustainability

5.1.1 Accessibility

The respondents were asked in Question 4 if Al Masmak Fort Museum and Riyadh National Museum were characterized by a clear entrance, good accessibility, and proximity to public transportation. Respondents strongly agreed that both RNM and MFM were characterized by a clear entrance, good accessibility, and proximity to public transportation (n = 23, 35%) were strongly agree. Most of the respondents in RNM agreed on the question (n = 30, 45.5%); however, respondents in MFM had a more average response than RNM (n = 14, 21%).

5.1.2 Green space

The respondents were asked in Question 5 if Riyadh National Museum was characterized by green spaces more than MNM in the outdoor environment (n=21, Most of the respondents in RNM agreed that RNM had more green spaces and outdoor environment than MFM (n=9, 32%), while respondents agreed that MFM had a greener outdoor environment than MFM (n = 27, 40 %). Furthermore, few respondents in RNM (n=21,

32%) has average result, were few respondents in both MFM and RNM had average results (n=8, 12%) were disagree about the question.

5.1.3 General services

The respondents were asked in Question 6 if Riyadh National Museum and Al Masmak Fort Museum were characterized by general services such as a mosque, café, and library. Most of the respondents agreed that RNM had more services for the visitors such as a mosque, café, and library (n = 24, 36.6%), while 41% (n = 27) agreed that RNM had more services. However, MFM has only a mosque for public visitors. Furthermore, few respondents in both MFM and RNM had average results (n = 9, 14%).

5.1.4 The Material

The respondents were asked in Question 7 if Riyadh National Museum and Al Masmak Fort Museum used local building materials such as Riyadh stone or clay. Most of the respondents strongly agreed that MFM was using local building materials such as stones and clay (n = 31, 47%), while 41% (n = 27) agreed that RNM was using more local building materials than MFM. Furthermore, few respondents in RNM had average results (n = 18, 27%). Shown in Figure 41, while (n=5, 8%) were disagree about the question.

The respondents were asked in Question 8 if Riyadh National Museum and Al Masmak Fort Museum used recycled building material. Respondents strongly agreed that MFM (n = 20, 30%) was using recycled building materials more than RNM, while both respondents agreed that RNM and MFM were using recycled building materials by 21% (n = 14), such as recycled stones and clay. Furthermore, few respondents in both MFM and RNM had average results (n = 26, 39%). While 9% were disagree about the question.

5.1.4 The water

Question 9 concentrated on water usage. The respondents were asked if Riyadh National Museum and Al Masmak Fort Museum were characterized by gray water usage for the outdoor landscape. Respondents strongly agreed that both were using it (n = 13, 20%), while 28.7% (n = 19) agreed that RNM was recycling gray water for the outdoor landscape. The respondents were in average agreement by 40% (n = 27) that MFM was recycling gray water more than RNM and disagreed by 13% (n = 9). Few strongly disagreed (n = 2, 3%).

5.1.5 Smart solutions in toilets

Question 10 concentrated on the smart devices used in toilets. Both respondents strongly agreed that both MFM and RNM were using smart devices in toilets (n = 19, 28.7%), while both 19.6% (n = 13) agreed that RNM and MFM were using the smart devices in the toilets more than MFM. In addition, 40% (n = 27) were average, few disagreed (n = 6, 24%). While 16% (n=11) were disagree.

5.1.6 The Energy

The respondents were asked in Question 11 if Riyadh National Museum and Al Masmak Fort Museum were using economic lighting such as LED lighting. Most of the respondents strongly agreed that MFM was using LED lighting more than RNM (n = 25, 38%), while only 36% (n = 24) agreed that RNM used LED lighting more than MFM. Few were average (n = 19, 28%). Only 6% were disagreed (n = 4, 6%).

5. 2 Smart solutions

The respondents were asked in Question 12 if Riyadh National Museum and Al Masmak Fort Museum were using smart solutions. In multiple choice questions, they were asked to select more than one option. Most of the respondents strongly agreed that MNM and RNM were used smart LED lighting (n = 40, 60%). Few of the respondents agreed that RNM used smart solutions more than MNM (n = 24, 36%). Respondents agreed in average numbers that both RNM and MFM were using the laser to clean the exhibits (n = 14, 21%). When the respondents were asked whether MFM and RNM were using artificial intelligence in the museum they showed average results of 20% (n = 13) in both MFM and RNM. The respondents were asked whether RNM and MFM were using virtual reality, and few respondents (n = 17, 26%) said that MFM and RNM were using it. The respondents were asked whether MFM and RNM were using the virtual tour in their websites, 22% (n = 15) respondents answered that both were using it.

5.3 Techno-Culture

The respondents were asked in Question 13 if Riyadh National Museum and Al Masmak Fort Museum were using techno-cultural solutions, in multiple choice questions. They were asked to select more than one option. Both respondents strongly agreed that MFM and RNM were using smart LCD screens, as shown in Figure 27 and Figure 10 (n = 39, 59%). Most of the respondents agreed that RNM used sound effects more than MFM (n = 39, 59%). The respondents agreed that RNM used video technology (n = 27, 40%) and MNM used video technology (n = 23, 34%). The respondents agreed that both RNM and MFM used the new technology–smart train when showing visitors, the main hall (n = 16, 24%), while the result for RNM was 19% (n = 13). The respondents were asked whether MFM and RNM were offering online conferences and lectures during COVID-19; few answered the question (n = 12, 19%). In addition, the respondents were asked whether MFM and RNM were using the outdoor plaza for cultural activities such as Saudi National day on 23 September every year; 24% answered the question that both were using it (n = 16). The respondents were asked whether MFM and RNM were offering the narrated virtual tour on their websites; the result for MFM was 16.6% (n = 11), while for RNM the result was 24% (n = 16). The last question in this section was whether MFM and RNM were displaying art by the NOOR Initiative on their front elevation, and the response for MFM was 21% (n = 14) and for RNM it was 24% (n = 16).

5.4 Health procedures

The respondents were asked in Question 14 whether Riyadh National Museum (RNM) and Al Masmak Fort Museum (MFM) were enforcing the health procedures in multiple choices questions. Most of the responders agreed on the questions (n = 19, 75%). In addition, they were asked to answer more than one question. A total of 56% (n = 14) agreed that everyone was using the sanitizer; 60% (n = 15) agreed that there was a warning (Do not Touch the product); 52% (n = 13) agreed that both MFM and RNM practiced social distancing; 60% (n = 15) agreed that there was a taking of the temperature near the front door; 52% (n = 13) agreed that they open the Tawakkalna app at the entrance.

Table 4.2: The results of the assessment method to evaluate the museums' performance post-COVID-19.

Focus	Question	Response MFM	RNM	Average	The average results of the 4 pillars
Sustainable site	Are the museums characterized by clear entrance-good accessibility-proximity to public transportation?	30%	32%	31%	31% Sustainable site
	Are the museums characterized by green spaces in the outdoor environment?	29%	32%	30%	
	Are the museums characterized by general services such as mosques-café-library?	30%	32%	31%	
The material	Are the museums characterized by using the local building materials	32%	32.3%	38%	34% The material

	such as Riyadh stone or the clay?				
	Are the museums characterized by recycling building material?	31%	30.3%	30.5%	
The water	Are the museums characterized by gray water for outdoor landscapes?	28%	29%	28.6%	29% The water efficiency
	Do they use smart devices in the toilets?	30%	29.6%	30%	
The energy	Are the Museums characterized by using economic lighting like LED lighting?	32%	32%	32%	32% The energy efficiency
Smart solutions	**Multiple choices**				
	Use of smart LCD screens?	62%	60.6%	61.3%	31 % The smart solutions
	Use of smart solutions?	30%	36%	33%	
	Use of a laser to clean the product?	16.6%	28%	26	
	Use of artificial intelligence?	16.6%	19.6%	22.3%	
	Use of virtual reality?	25.7%	24%	25%	
	Use of virtual tour?	23%	18%	20.5%	
Techno-Culture	**Multiple choices**				
	Use of lighting effect?	57.5%	59%	58	345% The techno-cultural solutions
	Use of sound effects?	37.8%	59%	48	

	Use of video technology?	34.8%	40%	27.4
	Use of new technology-smart train?	24.2%	19.6%	22
	Use of the outdoor plaza in cultural activities?	24.2%	27%	25.5
	Provide online conferences?	18%	18%	18
	Provide narrated online virtual tours?	16.6%	24%	20
	Display art by Noor Initiatives?	21%	24%	22.5
Health Procedures	**Does Al Masmak Fort Museum apply the health procedures post-COVID-19?**			
	Everyone is wearing a mask?	71	71	56 % Apply the health procedures
			72	
	Everyone is using sanitizer?	42	48	
			52	
	Do not touch the product?	51	46.6	
			58	
	Applying social distancing?	46	45.5	
			52	
	Taking temperatures at the front door?	51.5	47	
			50	
	Using Tawakklna software?	31.8	54.5	
			52	

The four pillars	Sustainable Site	The Materials	Water usage	Energy Efficiency	Smart solutions	Techno-cultural solutions	The health procedures

The Average results	31%	34%	29 %	32%	31 %	34%	56%

Table 4.3:The final result of the research evaluating the museums' performance post-COVID-19.
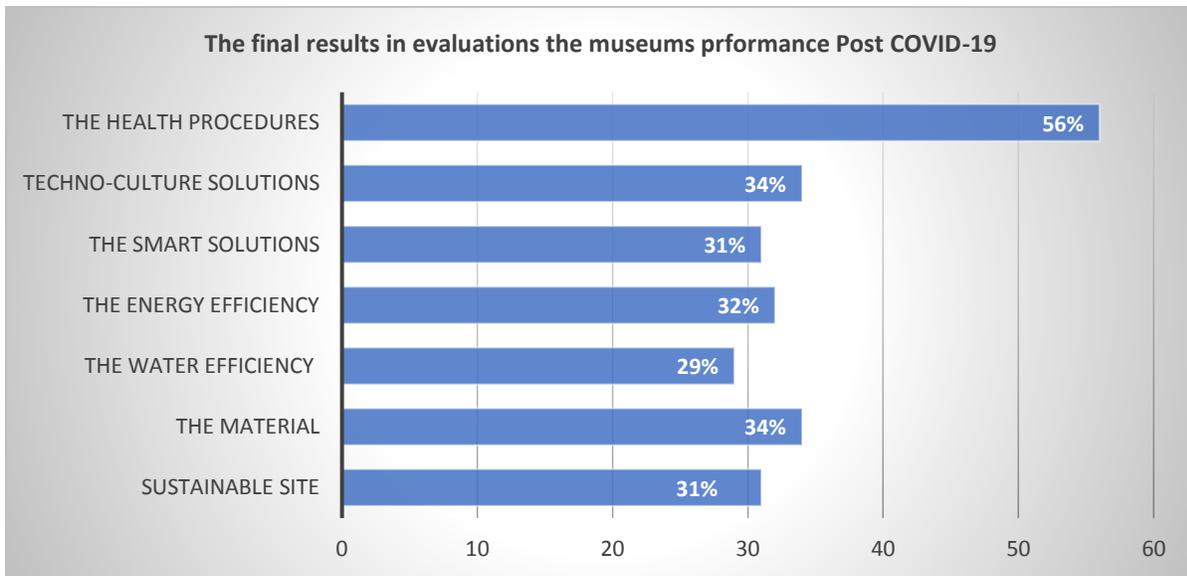
Figure 4.22. The result of the research evaluating the museums' performance post-COVID-19.

6. The Discussion

The discussion will focus on the result of the investigation of the four main pillars of the sustainable solutions research including accessibility, material, energy, water; smart solutions; techno-cultural solutions; and health procedures post-COVID-19. The survey was distributed from March to April 2021. The target number was 100 samples. The total number of respondents was 25. There was some limitation in collecting samples due to COVID-19 and the lockdown of the museums during 2020 and 2021. Figure 50 and it was recorded that visitor numbers from 2013 to 2019. After that, the museums were closed during the lockdown from 2020 to 2021. This period has a gap of no visitors and no services in the museums. They are expected to open again in late 2021.
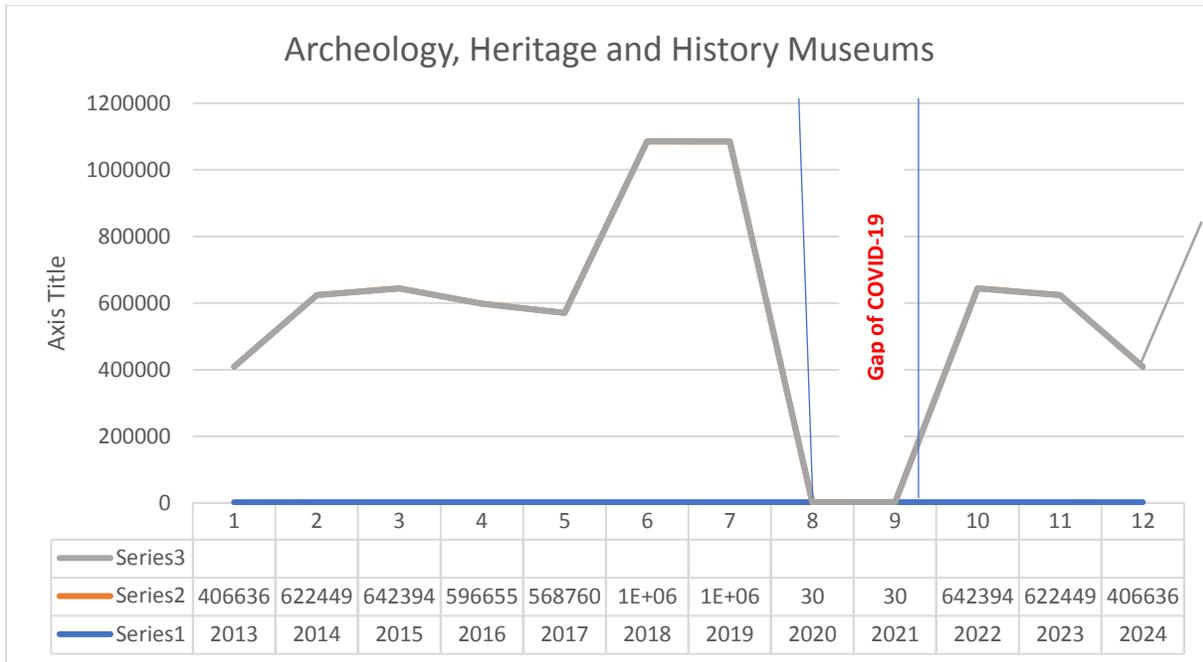
Figure 4.23. Statistical data (number of visitors in private, natural, and site museums in Saudi Arabia, 2013–2019) reflecting 2021 and 2022 [32].

Regarding Hypothesis 1: Riyadh National Museum (RNM) and Al Masmak Fort Museum are applying sustainable solutions in the accessibility and the site, the energy, the water, and the materials.

Sustainability

The researchers agreed with [7], who discussed in her book how we can bring sustainable water solutions to heritage sites, especially in the landscape. We agreed with this research and our research applied more water solutions such as recycling of gray water and the use of smart devices in toilets to safe water usage. In addition, the research agreed with [8] who discussed building life cycle. We applied more material solutions such as using local and recycled building materials. Additionally, most of the research discussed the energy efficiency in heritage buildings. We agreed with them and applied more energy solutions such as using economic lighting such as LED lights. In general, we found no research that discussed the sustainability value and solutions in museums.

According to the analysis, the respondents agreed that both RNM and MFM applied sustainability in accessibility, material, water, and energy.

Regarding accessibility, RNM had a more comfortable, clear access to the main entrance, and closer public transportation access than MFM as shown in Figure 2. In front of the MFM main entrance (Figure 14) there are some stones that discouraged access. Both museums are near public transportation, especially the new subway in Riyadh city.

Regarding the green space in the outdoor environment, the respondents indicated that RNM had more green space than MFM (as shown in Figure 12); the green outdoor space encourages people to come and visit the museum. Regarding the services, the respondents agreed that RNM offered more services to the public such as a mosque, café, and library; on the other hand, MFM had only a mosque and temporary gallery. The more services the museum provides to the public the more visitors the museum will have in the future. Regarding the material, the respondents agreed that both RNM and MFM used local building material such as Riyadh stones, gravel, sand, and clay to represent the local environment, as shown in Figures 13–14). Regarding the water, the respondents agreed that both RNM and MFM used smart devices to reduce water usage in the toilets, and they recycled water for the green areas in the outdoor environment. Figure 2 shows the outdoor water well (Figure 20) to represent the historical background of water usage in MFM. Regarding the energy, the respondents agreed that both museums used economic lighting such as LED light because it offers long-term usage and sustainability.

Smart solutions

Regarding Hypothesis 2: RNM and MFM are applying the smart solutions

The research agreed with [10,13, 26] in applying smart solutions. We suggested more advanced smart solutions, as shown in Figures 6,7,18. Regarding smart solutions, the respondents agreed that both museums were using smart LED lighting, smart solutions, laser cleaning of the exhibits, artificial intelligence, virtual reality, and virtual tours. RNM has a website that offers the virtual tour, shown in Figure 4.12; RNM also uses the smart screen in Prophet Mohamed Hall to display the history of Prophet Mohamed, as shown in Figures 6 and 7. On the other hand, limited smart solutions were found in MFM; it is using the smart screen to display the history of Riyadh, as shown in Figure 18, but there is no virtual tour in MFM. Both museums display the work of the Noor Initiative to present the heritage in the main elevation by using lighting techniques (Figure 4.21). Other approaches can be used in the smart solutions, such as the interactive kinetic screen between the halls where the children can stand and take photos as they are moving from one hall to another (Figure 4.24). Additionally, the museum can offer to take photos of visitors wearing their heritage clothes (Figure 4.25). In addition, the museum can use virtual reality online, especially nowadays because of COVID-19 and the lockdown (Figure 4.26). Both RNM and MFM need to apply smart solutions such as a virtual tour on their websites Figure 4.27.

Figure 4.24. Use of the kinetic energy screen to take photos in Londom.

Figure 4.25. Visitors can try on the clothes and take photos in MFM.

Figure 4.26. Use of virtual reality during the COVID-19 lockdown.

Figure 4.27. Use of the virtual tour on the website during COVID-19 in RNM.

Techno-Cultural solutions

Regarding Hypothesis 3: RNM and MFM are applying the techno-cultural solutions post-COVID-19

COVID-19 has brought to the surface the importance of applying techno-cultural solutions. Our research agreed with [20] in applying cultural value to the museums, but we applied more techno-cultural solutions in this research. Regarding the techno-cultural solutions, the respondents were asked to choose from multiple options in Question 13 (use of lighting effects, use of sound effects, use of new technology–smart trains, use of the outdoor plaza for cultural activities, provide online conferences, narrated online virtual tours, and art by members of the Noor Initiative). Both respondent groups agreed that RNM and MFM use techno-cultural solutions. Both museums use LED economic lighting techniques in different halls, soft spotlighting with sound effects. Sound effects are used in all halls, especially in the Prophet Mohamed Bridge in RNM, and there is an LCDL screen hall in MFM. Other new technologies could be used in the museums, such as the audio-visual hall shown in Figure 554, the seminar room in Figure 28, the virtual lecture and virtual conference in Figure 30 showing the researcher webinar with King Faisal Centre for Research and Islamic Studies during COVID-19 2021., the outdoor plaza celebration of National Heritage Day with the Noor Initiative using lighting techniques on the main elevation, as shown in Figure 31. More interactive solutions could be added to the museums

such as drawing arts, especially for kids and teens, 3D models and handicraft work, which will be very interesting to the women.

Figure 4.28. An audio-visual room.	**Figure 4.29.** Seminar discussion room.
Figure 4.30. Use of virtual lectures and forums post-COVID-19.	**Figure 4.31**. Use of the outdoor plaza in celebration of the National Heritage Day, with special lighting effects on the main elevation.
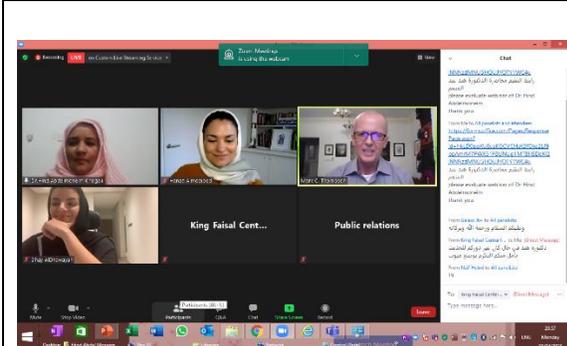
Heath procedures

Regarding Hypothesis 4: RNM and MFM are applying the health procedures post COVID-19

Regarding the health procedures, the research result agreed with [19] in applying the health proceedures in all public spaces during 2020–2021. Both respondents (RNM and MFM) agreed that RNM and MFM apply the health procedures. At this time both museums are closed by the government because of COVID-19, and only the administrative staff are working. Without visitors, health procedures such as wearing a mask, testing the temperature with a smart device, using the Tawakkalna app at the front door, and practicing social distancing are applied to the administrative staff. Shown in Figure 32 to Figure 35.

Figure 4.32: Apply the health procedure at the main entrance in MFM.
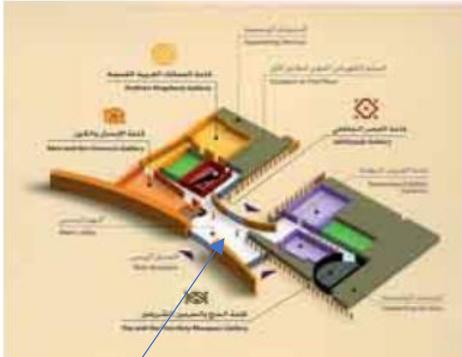
Figure 4.33: Apply the health procedure at the main entrance in RNM.

Figure 4.34: wearing the Mask in all spaces following his highness prince Mohammed bin Salman in applying the health proceadures in the Kingdom.

Figure 4.35: Open Tawakkalna before entering indoor spaces

Future research should focus on:

- Studying the urban context of the museums in Riyadh city.
- Providing interactive activities to the museums in Riyadh City.

7. Conclusion

The research was conducted to assess museums' post-COVID-19 performance. The result was obtained through a survey distributed from March to April 2021. The conclusions were as follows: Access should be clearer, comfortable, directly to the main entrance, and near public transportation access, especially the new subway in Riyadh city, to encourage people to visit the museums. There should be green space in front of the museum, and a large park should be provided to encourage people to visit the museum. In addition, the museum should provide more public services, such as a mosque, café, library, temporary gallery, lecture rooms, conference halls, and seminar rooms. Museums should use local building materials such as Riyadh stone, gravel, sand, and clay to represent the local

environment. Economic light sources such as LED lighting should be used for durability and sustainable usage. Besides that, museums should apply water efficiency solutions such as smart devices in toilets and recycling gray water for irrigation of the green space in the outdoor environment. Museums should also apply smart solutions, such as the use of a laser to clean the products, artificial intelligence, virtual reality, and virtual tours on the museum website. Museums must apply techno-cultural solutions such as lighting and sound effects, new technology–smart trains, the outdoor plaza for cultural activities, online conferences, display of art by the Noor Initiative, audio-visual hall, seminar rooms. Finally, to prevent the spread of coronavirus after the lockdown, the museums must place health restrictions on the administrators, technical personnel, and visitors, such as wearing a mask, taking the temperature with a smart device, using the Tawakkalna app (launched by the Saudi Ministry of Health to help prevent the spread of coronavirus) near the front door, and practicing social distancing.
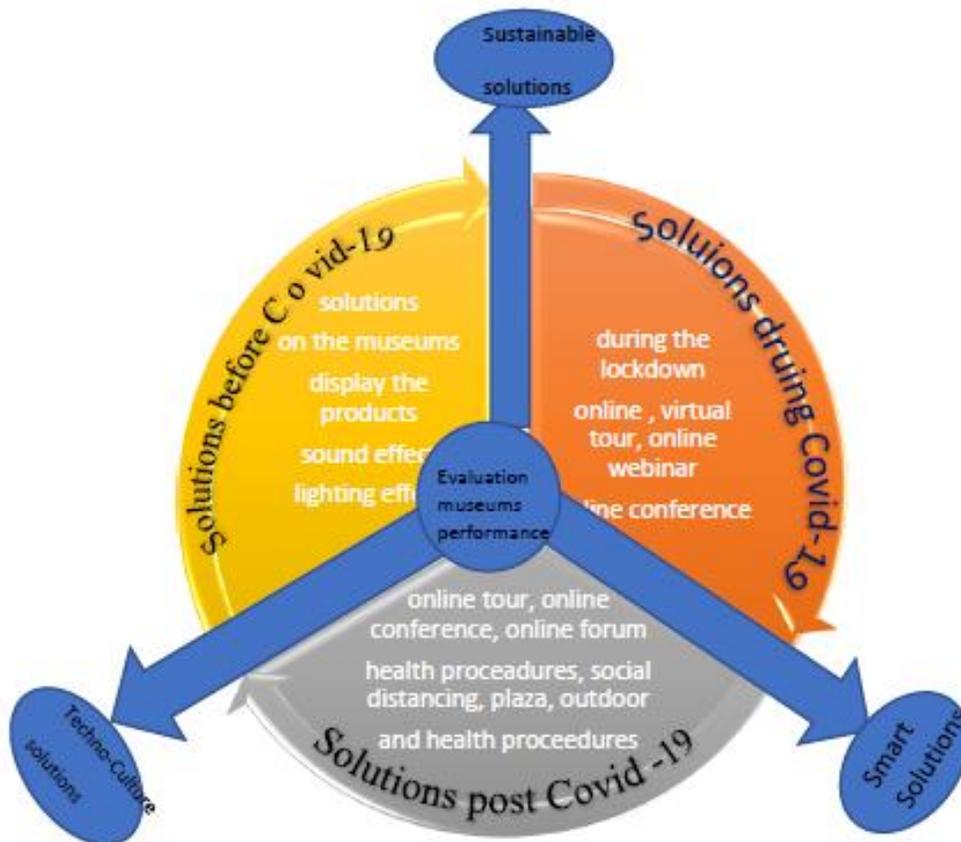
Figure 4.36: The proposed interactive 3D model to evaluate museum performance before COVID-19 in applying solutions in the museums such as lighting effect, sound effect, smart screen. During COVID-19 applying solutions such as online webinars, online conferences, online tour. and post-COVID-19 apply solutions such as both online and face to face when the museums open in sustainability, smart, and techno-cultural solutions.

Acknowledgement

References:

[1].UNESCO, 2021. *What is meant by "cultural heritage"?*. [Online] Available at: http://www.unesco.org/new/en/culture/themes/illicit-trafficking-of-cultural-

[2] Berg, F., 2018. Life cycle assessment and historic buildings: energy-efficiency refurbishment versus new construction in Norway. *Journal of Architectural Conservation,* pp. 152-167, DOI: 10.1080/13556207.2018.1493664.

[3] Kalliopi Fouseki *, D. N. K. S. M. C. S. N., 2020. *Atmosphere,* p. 604; doi:10.3390/atmos11060604.

[4] Tadeu, S. F., 2015. *Energy Retrofit of an Historic Building in a UNESCO World Heritage Site: an integrated Cost Optimality and Environmental Assessment.* Madrid, Spain, University of Coimbra, pp. 1-15.

[5] Fernando, S., 2014. *Energy Retrofit of an Historic Building in a UNESCO World Heritage Site: an integrated Cost Optimality and Environmental Assessment.* Madrid, Department of Civil Engineering, FCTUC, University of Coimbra.

[6] Stefano, P., 2014. *Macroseismic Method for Vunerability Assessment for Rationalist Architecture Heritage.* UK, Science Direct, pp. 173-180.

[7] Hein, C., 2020. *Introduction: Connecting Water and Heritage for the Future.* UK: Springer, ISBN 978-3-030-00267-1.

[8] Fuglseth, F. B. &. M., 2018. Life cycle assessment and historic buildings: energy-efficiency refurbishment versus new construction in Norway. *Journal of Architectural Conservation,* pp. 152-167, DOI: 10.1080/13556207.2018.1493664.

[9] Elborombaly, H., 2020. Smart Green Maintenance for Buildings. Riyadh City, Arabian Operation and Maintenance Center (OMAINTEC).

[10] Khan, M. A., 2011. *Assessment of R-Value Effective of Building Envelope Using High Definition Thermal Image Technique* , Dahran, Saudi Arabia: King Fahad University. https://eprints.kfupm.edu.sa/id/eprint/138440

[11] SEMTECH, 2019. *Capgemni Delivers Smart Building Transformation,* UK: Semtech.com.
https://www.semtech.com/uploads/technology/LoRa/SmartBuildingsTransformed-WhitePape-final.pdf

[12] Amrutha, 2020. Imagining the COVID-19 pandemic through the minds of 9-11 years. *Public Health,* p. https://doi.org/10.1016/j.puhe.2021.01.007.

[13] Tan, M.K.B., Feb, 2021. Curating wellness during a pandemic in Singapore: COVID-19, museums, and digital imagination. *Public Health,* p. https://doi.org/10.1016/j.puhe.2021.01.006.

[14] Biraglia, A., 2020. Corporate sponsorship for museums in times of crisis. *Annals of Tourism Research,* p. https://doi.org/10.1016/j.annals.2020.103056.

[15] Dewi, R., 2016. *The Rapid Assessment of Heritage Area Method for Kemasan Heritage Area.* Indonisia , Science Direct. DOI: 10.1016/j.sbspro.2016.06.133

[16] Solution, E. D. (15-5-2020). *Post COVID-19 Workplace Strategies.* Vasant Vihar, New Delhi: Environmental Design Solution Pvt Ltd. https://www.indiamart.com/environmental-design-solutions-pvt-ltd/

[17] WHO. (2020, MARCH 16 Monday). *Word Health Organization.* Retrieved from Coronavirus disease (COVID-19) pandemic: Coronavirus disease (COVID-19) pandemic

https://en.unesco.org/cultnatlaws

[18] Control-2, S. C. (2020). *Booklet orientation Against COVID-19 in workplace.* Saudi Center of Desease Prevension and Control. https://www.cdc.gov/globalhealth/countries/saudi_arabia/default.htm

[19] Khogali, H., 2020. *The Effect of COVID-19 on Sustainable Teaching and learning ,* Canada: Modern Applied Science. https://doi.org/10.5539/mas.v14n8p44

[20] MEED. (2020). *COVID-19 Sparks Contract Issues.* UK: MEED Business

Municipility, A. R., 2020. *Riyadh Museums.* [Online] Available at: https://www.alriyadh.gov.sa/en/riyadh/DiscoverRiyadh/Pages/details.aspx?cat=Museums&cat2=%D8%A7%D9%84%D9%85%D8%AA%D8%A7%D8%AD%D9%81 [Accessed 21 Sunday May 2021].

[21] Sameh, S., 2020. *The Influence of COVID-19 and QUARANTINE on our Life Style and Home Design,* Jedda: s.n.

CHAPTER FIVE

Comparison of Four Global Sustainable Building Rating Systems Carried out With Focus on Hot and Dry Climate

Comparison of Four Global Sustainable Building Rating Systems Carried out With Focus on Hot and Dry Climate

Khogali, H., 2016

Abstract

Several assessment programs has been developed worldwide on the environmental and energy effect of buildings. The aim of this study is to identify the main and subcategories of sustainable design. The researcher has investigated and compared four global building rating systems, namely leadership in Energy and Environmental Design (LEED) in USA, Emirates Green Building Rating System (ESTIDAMA) in Abu Dhabi city, Qatar Sustainability assessment System (QSAS) in the State of Qatar and Australian green Star rating system (AGBC rating system), in Australia. This paper focuses mainly on their processes, contents, similarities and differences, processes, evaluation, their development and wither these systems are applicable to all environments?

The paper outlined six main categories developed by these global rating systems being: Sustainable site, indoor environmental quality, materials, water efficiency, power supply system and innovations. Subcategories were added according to their social, cultural, economic and legislations conditions.

The paper recommended adding four main categories suitable to hot and dry climate.

Keywords: *LEED system, ESTIDAMA system, QSAS system and Australia green star system, similarities and differences categories, categories for hot dry climate*

5.1. Introduction

1.1 Definition of Rating System

Rating systems have become a universal trend, many countries around the word apply the rating system on building construction, and it is defined by the leader in energy and environment (LEED) as**:**

> *'Rating systems are groups of requirements for projects that want to achieve LEED certification. Each group is geared towards the unique needs of a project or building type'.* (Council, 2014)

Another definition provided by South Africa Green Building Council which is:' *the rating system sets out a "menu" of all the green measures that can be incorporated into a building to make it green. Points are awarded to a building according to which measures have been incorporated, and, after appropriate weighting, a total score is arrived at, which determines the rating'.* (Council, 2013).

5..1.2 The Previous Studies

The first study has been presented by (WAN, 2014) LEED in a paper on Energy Star, Green Globes, BREAM, CASBEE, NABERS, High quality environmental standards, HK BEAM, Green mark Scheme, GB Tools, AND GBI. The paper discussed each system process, content, main categories, issues and rationalizing the GBI system in Malaysia.

The second study prepared by (Fenner, March-2008) to discuss LEED and BREAM tackling the main categories and rating method, cost assessment, accessibility vision for future. (Thaimosy, 2006) prepared the third study in which he has provided deep analysis of the development of LEED and Green Globes, and analysed the LCA, a preliminary assessment of the environmental relevance. The forth study prepared by (Fowler, July-2006) and came in a report providing deep analysis to LEED, CASBEE, GB Tools, Green Globes and LEED. The report has revised the methods usability, durability, main categories, rating and process, applicability and development, usability, system maturity, technical content, measurability. The sixth study has been a paper prepared by (Haapio, 2007), the paper studied the existing environmental assessment tools, the main categories, assessed buildings, users of tools.

5.1.3 The Methods

1.3.1 United Arab Emirates Green Building Rating System in Dubai

The Emirates Green Building Council (EGBC) has been formed in 2006, with the purpose of advancing the green building principles for environmental protection and ensuring sustainability in the United Arab Emirates, today (EGBC) is actively supporting the UAE to be one of the five global leaders helping to reduce the ecological footprint of the sustainable building environment by 2015. (Council, 2007)

5.1.3.2 Estidama Assessment System

Established in 2008 by The Abu Dhabi Urban Planning Council (UPC) and has been internationally recognized for large-scale sustainable urban planning and for rapid growth.

"ESTIDAMA" is the Arabic word for sustainability, it is an initiative developed and promoted by the UPC. ESTIDAMA is the intellectual legacy of the late Sheikh Zayed bin Sultan Al Nahyan and a manifestation of his visionary governance promoting thoughtful and responsible development, while creating a balanced society based on the four equal pillars of sustainability: environmental, economic, social, and cultural. ESTIDAMA goal is to preserve and enrich the physical and cultural identity of Abu Dhabi, while creating an always-improving quality of life for its residents.

The early foundations and aspirations of ESTIDAMA are incorporated into Abu Dhabi vision 2030 and other UPC policies such as the Development Code. ESTIDAMA has been created eight years ago (2008) as the first program of its kind tailored to the Middle East region environment. In the immediate term, ESTIDAMA is focused on the rapidly changing built environment. In this regard the UPC is making significant strides to influence projects under design, development, or construction within the Emirate of Abu Dhabi. An essential tool to advance ESTIDAMA is the Pearl Rating System, specifically tailored to the hot climate and arid environment of Abu Dhabi, by supporting the social, cultural traditions and Abu Dhabi cultural values. All new projects must achieve a minimum 1 Pearl rating to receive the approval of the planning and permitting authorities. Government funded buildings must achieve 2 Pearl rating as minimum. (Council, 2010)

5.1.4 Qatar Sustainability Assessment System (QSAS)

Has been started in 2007 to create a sustainable built environment minimizes ecological impact while addressing the specific regional needs and environment of Qatar. The built environment contributes to air pollution exposure, land use and contamination, fossil fuel depletion, water depletion, materials depletion, impacts on human health, and climate change. Responsible design, construction and building operations can mitigate the negative

effects of the built environment. QSAS started in 2007. (Diar, Oct. 2010) presented a paper in NGO PANEL SESSION: Focusing on the vital role played by NGOs to encourage organizations to act sustainably and raise awareness of green issues in the Kingdom Saudi Arabia.

CASE STUDY: Developing a sustainability rating system in the GCC countries: Qatar Experience: represents an overview of the region's first performance based sustainability rating system, Qatar Sustainability Assessment System (QSAS) as a model. The system consists of eight main categories which are: management, culture and economic value, water, energy, material, human comfort, and indoor environmental quality. Today 1000s building designed under this system illustrating the rating system. The research programs included, but not limited to:

    I.   energy conservation and efficiency,

    II.   renewable energy,

    III.   materials, water,

    IV.   recycling & transportation

5.1.5 Leadership in Energy and Environmental Design (LEED)

LEED, or Leadership in Energy and Environmental Design, is an internationally recognized green building certification system. Developed by the U.S. Green Building Council (USGBC) in March 2000, LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations, and maintenance solutions.

(City, 2011) This system explicitly allows environmental and social factors, including site, water, energy, materials, and indoor air quality, to be weighed side by side with financial metrics in the design process. The growth of the USGBC is a testament to the exploding interest in ecological approaches to building design. USGBC membership has grown tenfold since 2000, and now includes over 6,300 companies and organizations. (Haselbach. L., 2008), presented introduction to sustainable construction and discussed LEED system and principles. United States Green Building Council USGBC (Council, 1996) discussed the environmentally sustainable development main issues

1.6 Green Star Rating System of the Green Building Council of Australia

Green Star is a comprehensive, national, voluntary environmental rating scheme that evaluates the environmental design and achievements of buildings. Green Star was developed for the property industry to: Establish a common language, set a standard of measurement for green buildings, promote integrated, whole-building design; recognize environmental leadership, identify building life-cycle impacts; and raise awareness of green building benefits. Green Star covers a few categories that assess the environmental impact that is a direct consequence of a projects site selection, design, construction, and maintenance. The nine categories included within all Green Star rating tools are: Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions, Innovation (Australia, 2015).

5.2. Objectives

    1) To identify the definition of the rating system

    2) To introduce the International Sustainable Rating systems that will be discussed in this study: LEED V4, AUSTRALIA GREEN STAR BUILDING RATING SYSTEM (AGB), ESTIDAM and QSAS.

    3) To study and discuss the systems in process, categories, sub issues, development, applicability, more similarities and differences.

4) To suggest additional category that is important for hot dry climate and not implemented by the global methods.

5) To give guideline to sustainable assessment method for hot dry climate

5.3. Methodology and Sub Headings

The methodology begins by literature review of the previous studies to study and compare between four international sustainable assessment methods which are LEED V4, AUSTRALIA GREEN STAR BUILDING RATING SYSTEM (AGB), ESTIDAM and QSAS. The documents are available through their websites. Then, method of presentation is presented in tables and figures to identify the main categories of each system, sub issues, process, method of evaluation, and the certificate levels. This has been followed by; deep analysis and discussion of the main categories: Sustainable site, indoor environment, energy, water, and materials to identify the similarities and differences. The second part of the study focuses on studying the additional categories suitable to hot dry climate. The study outlines the main categories which should be implemented by any international sustainable building rating system with respect to environmental, social, economic aspects and identifying the additional categories suitable to hot dry climate.

5.4. Result/Findings

I. The comparison shows that there are similar Categories shared between the four global rating systems, LEED, Australia Green Star rating system, ESTIDAMA and QSAS, namely: Sustainable Site, Indoor environmental quality, Energy, water material and innovation.

II. As well; there are additional categories introduced by these global systems:

Australia green star system provided new additional categories, which are management, transportation, and land ecology. ESTIDAMA added: Urban community, Culture and economic value, integrated development process. QSAS: Culture and economic value. The system added these new categories aiming to connect the design with local culture, economic and local community, and local environment.

III. There are similarities and differentiations observed in each Category existing in the main issues, and which are attributed to the deference in location, environmental conditions, natural resources, culture, and economic aspects.

IV. The total points of LEED v4 are (110 points), Australia (100 points), ESTIDAMA (159 points), and QSAS has (100, 500, 1000 points).

LEED uses points in evaluation and the categorization ranges from silver, Gold, Platinum. GBA uses Star Rating System and the categorization range from one star to six stars, ESTIDAMA uses Pearl rating system and the categorization range from one pearl to six pearl and QSAS uses star rating system.

V. Each system has a certain process identified in their website; LEED certification involves five primary steps: Determine which rating system used, Registration of project, Submission of certification application and paying a certification review, await the application review, receive the certification decision. Green Star Certification uses a formal process which involves a project using a Green Star rating tool to guide the design or construction process during which documentation. The Green Building Council of Australia will commission a panel of third-party Certified Assessors to validate the documentation and there are two rounds of Assessment available to a project for which to achieve validation of credits claimed. The Development Review Process has been introduced by Dhabi Urban Planning Council (UPC) to provide a streamline process for reviewing development proposals. In QSAS the process starts by submission of the project, preliminary review, appealing of the certifying body's decision, final review and Certification.

VI. Sustainable site similarities are heat island effect and -site development; on the other hand the differences in LEED V4 site assessment, site development, open space, rain water management, heat island reduction and light pollution reduction. QSAS has added more additional issues in site category like Ecological Value of Land; ESTIDAMA and Australia rating system: does not have sustainable site.

VII. In the Indoor Environment the similarities increase: Ventilation Construction, Low-Emitting Materials, Composite Wood & Agrifiber Products, Daylight & Views, Daylight 75% of Spaces, Thermal Comfort. On the other hand, in LEED V4 the differences minimize: indoor performance, environmental tobacco control, enhance indoor air quality control, low emitting materials, thermal comfort, day lighting, views and acoustic performance. Australia rating system added HVAC system and pollutants. QSAS added Monitoring air temperature and quality and adjusting or calibrating as appropriate and Mechanical ventilation.

VIII. In Energy the similarities are: Optimize Energy Performance, On-Site Renewable Energy, Measurement & verification green power. On the other hand, the differences in LEED V4 are: Fundamental commissioning and verification, minimum energy performance, energy metering, renewable energy, refrigerant management, and green power. Australia rating system added HVAC System Simulations, building Envelope, A/C Pumping, and Modelling Information. ESTIDAMA added Community Energy Strategy, Building Energy Guidelines, Energy monitoring and reporting and Community Strategies for Passive Cooling, QSAS added Energy Demand Performance, Energy Delivery Performance, and Fossil Fuel Conservation.

IX. In water the similarities are water Efficient Landscaping, Water Use Reduction. On the other hand, the differences in LEED V4 are outdoor water use reduction, indoor water use reduction, water metering and cooling tower water use. Australia rating system added solar collectors, Hot water rating load, Measurements, water reuse. ESTIDAMA added Community Water Strategy, Building Water Guidelines and Water Monitoring. QSAS: added Water Consumption.

X. In materials the similarities are Construction Waste Management, Materials Reuse, Recycled Content, Regional Materials, and Certified Wood. On the other hand, the differences in LEED V4 are construction waste management planning, building life cycle analysis, environmental products, use of raw materials, Australia rating system added Eco content, durability, environmental management system. ESTIDAMA added Basic Construction Waste Management, Reused or Certified Timber. QSAS added recycling content and regional building materials.

XI. The logic of rating system is open mind for all specialists who can share solutions by their experience and specialization.

XII. The conclusion arrived at through this analysis, is that rating system is an ever-evolving process, and its improvement depends on the best practice of users and experts. In each version we have more challenges, and the total points are increased to achieve a higher certificate

XIII. As a matter of fact, it contains sub issues that help in managing a certain local and global problems, for example, local problems: storm water design in Sustainable site category; and for global problems, examples are: that have an effect on the local environment heat island effect, smoke control, optimize energy performance.

XIV. By this comparison, we can fix five main categories for sustainable eco buildings, which are sustainable site, Energy, water, material, indoor environmental control.

XV. More categories, suitable to our local environmental conditions, could be added e.g.: culture, social aspect, and local legislations. The issues are detailed according to our local interest and environmental problems visualized for Greater Khartoum as the case study lays in hot dry climate. The research gives a frame work for assessment method suitable to

hot dry climate such as Greater Khartoum. In addion to the five basic categories: sustainable site, indoor environmental quality, water efficiency, energy efficiency and material. The research outlines the following categories:

15.1 A category about health and safety procedure could been added as an important aspect. It is extremely important to add Health, Safety and Environment as new Category. Only green star rating system and ESTIDAMA adds land ecology as an important category. *Only ESTIDAMA and QSAS included the outdoor environment as important category in 2010.

15.2 It is very important to include Outdoor thermal control as a new Category. Improving of the outdoor environment is imperative in Sudan as it provides thermal control, and it can be achieved by provision of sheds, terraces, balconies, swimming pools, fountains; maximizing outdoor space for its physiological, ecological , economic, and social effect as specified, and to make the air more humid and comfortable.

15.3 The environmental design process as important category. It is very important to add Environmental Design Process in all design process.

15.4 The research recommended studying building form as an important category. Studying of building form according to site location and local environmental conditions and solar angle will provide more shades to the building and will minimize the solar radiation absorbed by the walls and minimizes air temperature around the house. Researchers found that L-shape and U-shape forms, both are more effective in hot dry climate. Form can be studied on cultural and social basis, taking into consideration the courtyard system. In this respect, research have approved that courtyard system contributes to cooling down air temperature during daytime, and minimizes radiation, technological aspect may be added.

15.5 Studding of culture and economic value, it is essential to add Community aspect as community participation, social aspect, culture aspect and economic value.

15.6 The research recommends that all types of projects, applicable, durable, developed by government, private sector, industry, NGOs and provide continuous review through using of expert's opinions, durable for long time and provide LCA, by providing durable eco building materials, re-use, recycling, re-processing contents.

5.5. Analysis and Discussion

The discussion contains two main parts

Part one:

Discuss four global systems in: the main process, method of evaluation, the total points in each category, the process, the certificate level, the main categories, sub issues, similarities and differences, additional categories were added by the global assessment methods, availability, applicability and development.

Part two:

discuss additional categories suitable to hot dry climate.

5.5.1 Part One: Dicuss of 4 Global Sustainable Assessment Methods

5.5.1.1 The Main Category

According to Table 1, we can conclude:

Table 5. 1. The main categories of the systems

The main Categories	LEED v4	Australia green star rating system	Eteadman	QSAS
Sustainable Site	●	●	○	●
Indoor environmental quality	●	●	○	●
Energy and atmosphere	●	●	●	●
Water Efficiency	●	●	●	●
Material and resources	●	●	●	●
Innovation in design	●	●	●	●
Regional priority	●	○	○	○
Management and operation	○	●	○	●
Transportation	○	●	○	○
Land Ecology	○	●	○	○
Urban community	○	○	●	●
Culture and economic value	○	○	○	●
Integrated development process	○	○	●	○
Natural system	○	○	●	○

- ● Means its applicable
- ○ Means it's not applicable

I. **LEED** provides six main categories, which are sustainable site, indoor environmental quality, energy and atmosphere, water efficiency, materials and resources and innovation in design.

II. **Australia green star rating** system provides nine main categories which are sustainable site, indoor environmental quality, energy and atmosphere, water efficiency, materials and resources, innovation in design, management and operation, transportation, and land ecology.

III. **ESTIDAMA** rating system provides seven main categories, which are energy, water, material, innovation, urban community, culture and economic value, integrated development process and natural system.

ESTIDAMA rating system adds urban community, integrated development **process and natural system.**

Urban community:

- The Liveable Communities section is intended to encourage responsive design and sustainable land use.

- through the following:

- Thorough analysis and assessment of the social, economic, design and policy context.

- Provision of community facilities in the right place, time and at the right level.

- Analysis and appreciation of the climatic conditions.

- The efficient and effective use of land.
- Outdoor Thermal Comfort Strategy.

Creating a community that is easy to move around by all modes including pedestrian and cycling and enables excellent connections to the wider sub region; providing for a diverse and inclusive population; and providing opportunities for commerce and trade at an appropriate level.

Abu Dhabi Urban Planning Council (Council, 2010)

Integrated development process: Sustainable building guideline, Integrated Development Strategy Sustainable Building Guidelines, Community-Dedicated Infrastructure Basic Commissioning, Life Cycle Costing, Guest Worker Accommodation Construction Environmental Management, and Sustainability Awareness.

Natural System: To minimize demand for resources, promote soil protection and enhancement and ensure the long-term survival and management of landscaped / habitat areas.

IV. **QSAS** rating system consists of nine main categories, which are sustainable site, indoor environmental quality, energy, water, material, innovation, management and operation, urban community and culture and economic value.

The similarity categories are sustainable site, indoor environmental qualities, energy, water, materials and innovation in design.

The differences are the Australia green star rating system added; management and operation, transportation and land ecology.

Management and operation: Credits address the adoption of sustainable development principles from project conception through design, construction, commissioning, tuning and operation

Transportation: Credits reward the reduction of demand for individual cars by both discouraging car commuting and encouraging use of alternative transportation.

Land ecology: Credits address a project's impact on its immediate ecosystem, by discouraging degradation and encouraging restoration of flora and fauna.

QSAS rating system added urban community and culture and economic value.

The community: Consists of factors associated with cultural conservation

And support of the local economy.

Culture and economic value: Consist of factors associated with the urban environment such as zoning, transportation networks and loadings. Loadings on the urban environment include traffic congestion and air, noise, and light pollution. (Diar, Oct. 2010).

5.5.1.2 Method of Evaluation

Each system has it is own method of evaluation some are points others are weighing:

Table. 2 presents the method of evaluation of the Systems:

Table5. 2. Method of evaluation of the systems

Method of evaluation	LEED System	Australia green star rating system	ESTIDAMA	QSAS
	points	Star rating system	Pearl rating system	Weighing And QSAS star system

LEED uses points, GBA uses Star Rating System, ESTIDAMA uses Pearl rating system and QSAS uses QSAS star system.

5.1.3 The Total Points of Each Category on Each System

I.**LEED V4**:

Table 3 shows the total points of each category LEED V4 concluded as follows:

Table 5.3. The total points of each category on LEED V4

LEED V 4:	
Location	16
Sustainable Site	10
Indoor Environmental Quality	16
Water efficiency	11
Energy and atmosphere	33
Material	13
Innovation	6
Regional priority	4
Total points	110

Source: usgbc.org.

LEED V.4 provides points to evaluate each category, location (16), sustainable site (10), indoor environmental quality (16), water efficiency (11), energy and atmosphere (33), material (13) innovation (6) Regional priority (4). They give load and more challenges to energy and atmosphere and indoor environmental quality. Moderate points are given to location, sustainable site and materials and less point to water efficiency and innovation and regional priority.

II.**Australia Green Star Rating System**

Table 4 shows the evaluation method is staring system and its range , one star (10-19), two star (20-29), three star (30-44), four star (45-59), five star (60-74) , six star (75+). The certified project starts from three stars.

Table 5.4. Australia green star rating system points of each category

Australia Green Star Rating System	
One star	10 - 19 pts
Two star	20 - 29 pts
Three star	30 - 44 pts
Four star	45 - 59 pts Best Practice

Five star	60 - 74 pts Australian Excellence
Six star	75+ pts World Leader,
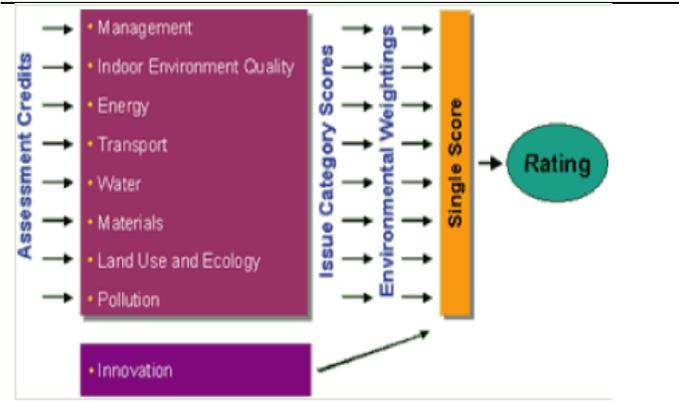
Source: Green Star (2008)

III.ESTIDAMA

Table 5 shows the total points of each main category for ESTIDAMA and concluded as follows: ESTIDAMA, points also are used to evaluate each category, integrated development process (10), Natural system (14), livable communities (38), precious water (37), resourceful energy (42), stewarding materials (18) and innovation (3). They give load and more challenges to livable communities, water and energy. Moderate points are given to natural systems and stewarding materials. And less point are given to integrated development process and innovation.

Table 5.5. ESTIDAMA total points of each main category

ESTIDAMA	
Integrated Development Process	10
Natural Systems	14
Livable Communities	38
Precious Water	37
Resourceful Energy	42
Stewarding Materials	18
Innovating Practice	3
Total	**159**

Source: (Council, 2010)

IV.QSAS

Table 6 shows the total weight of each category on QSAS concluded as follows:

Table 5.6. QSAS Total weight for each category

QSAS total weight:	
Urban community	0.24

Site	0.27
Energy	0.72
water	0.48
Material	0.24
Indoor Environmental Quality	0.42
Culture and economic value	0.39
Management and operation	0.24
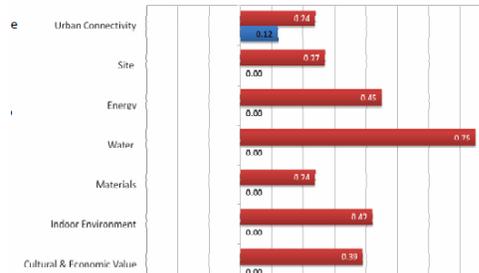
Source: (Alhor, 2009)

QSAS provides urban community (0.24), Site (0.27), Energy (o.72), water (0.48), indoor environmental quality (0.42), culture and economic value (0.39, management (0.24).

5.1.4 The Process

i.   LEED PROCESS

LEED certification involves five primary steps

1 **Determine which rating system** used and prepare your certification application. Applications differ depending on the building type and the LEED credits decided to pursue.

2 **Register your project.** Registration is a flat fee paid up front at the time of registration; rates are based on the date of registration. The certification fee is based on your project's rating system and size; it is calculated and paid when the project team submits documentation for review in LEED Online.

3 **Submit your certification application and pay a certification review** fee. Fees differ according to building type and square footage.

4 **Await the application review.** Review processes differ slightly for each building type.

5 **Receive the certification decision**, which you can either accept or appeal. An affirmative decision signifies that your building is now LEED certified. www. usgbc.org

ii.   GBC OF AUSTRALIA PROCESS

1. Green Star Certification is a formal process which involves a project using a Green Star rating tool to guide the design or construction process during which a documentation-based submission is collated as proof of this achievement.

2. The Green Building Council of Australia will commission a panel of third-party Certified Assessors to validate that the documentation for all claimed credits is in adherence with the Compliance Requirements as outlined in the Technical Manual that accompanies each rating tool.

3. There are two rounds of Assessment available to a project in which to achieve validation of credits claimed. Project teams are notified of their score based on the recommendation of the Assessment Panel and, where applicable, of any innovation credits that have been awarded by the GBCA. If a Certified Rating is awarded, the project will receive a framed certificate, award letter marketing kit and relevant Green Star logos Project types on table.

iii.   ESTIDAMA PROCESS

The relationship existing between the UPC Development Review Process, ESTIDAMA, the Pearl Rating System and the Development Review Process has been introduced by

Dhabi Urban Planning Council (UPC) to provide a streamline process for reviewing development proposals. The process comprises four steps: Enquiry, Pre-Concept Stage, Concept Planning Review and Detailed Planning Review. The UPC uses this review process for two main purposes: To ensure that the development proposals comply with the Emirate's urban planning policies (e.g. land uses, Densities, ESTIDAMA). To coordinate the review and approval of development applications by external government agencies.

iv.   QSAS WEB PROCESS

Project Status: Identifies the project's current phase in the assessment process.

Submission in Progress: In this phase, criteria are assigned to team members on the Project Home and supporting documentation for each criterion is uploaded by the project team on the Criterion Home.

Preliminary Review: After the submittal of the design criteria, the certifying body will notify the project manager of any insufficient or incomplete criteria documentation. Failure to resubmit correct documentation will result in a score of -1 for that criterion. The preliminary review phase is also the time for the design team to submit any questions to the certifying body that are outside of the scope of any QSAS prescriptive approaches or calculators. The certifying body will provide guidance on the approach to be taken to complete the assessment of the criterion.

Appeals: The project team may choose to appeal the certifying body's decision in regard to the scoring of a specific criterion after the final review process. The applicant must, via the appeals process, provide sufficient proof that the criterion should score differently. The project will pay a fee for each criterion appeal. All appeals must be submitted within one month of the final review of the project's design phase criteria.

Final Review

The certifier has completed the Preliminary Review. Any criteria marked "resubmit" is resubmitted by the project team for a Final Review by the certifying authority. In this phase, the certifier assigns the remaining criteria a score and to determine a final project score.

Certification

Final review is complete, and the project team can view the final project score. If the project team feels a score is incorrectly assigned, a criterion can be resubmitted through the appeals process. (Diar, Oct. 2010).

5.1.5 The Certificate Level

USA LEED V.4 used (certified-gold-silver-Platinum), Australia star rating system used Star rating system for QSAS used star and weighing system and ESTIDAMA used Pearl system as follows:

i. LEED V4. CERTIFICATE LEVELS

Table 7 shows the certification and the range points

Table 5. 7. U.S.GBC"LEED" v4. Certified level

Certified	Range of points
Certified	40-49 points
Silver:	50-59 points,
Gold	60-79 points,
Platinum	80 Points and above

(40-49) certified, (50-59) silver, (60-79) Gold and 80+ Platinum

ii. AUSTRALIA GREEN STAR RATING SYSTEM CERTIFICATE

(Table. 8) shows Green Star ratings are determined by comparing a project's overall score with the following rating scale: Australia uses one star, two stars, three stars, four stars, five stars, six stars.

Table 5.8. GBCA Certificate levels

GBCA	
One star	10 - 19 pts
Two star	20 - 29 pts
Three star	30 - 44 pts
Four star	45 - 59 pts Best Practice
Five star	60 - 74 pts Australian Excellence
Six star	75+ pts World Leader,

Source: (Australia, 2015).

iii. ESTIDAMA CERTIFICATE LEVEL:

(Table 9) shows within each section there are both mandatory and optional credits and credit points are awarded for each optional credit achieved. To achieve 1 Pearl rating, all the mandatory credit requirements must be met. To achieve a higher Pearl rating, all the mandatory credit requirements must be met along with a minimum number of credit points.

Table 5.9. ESTIDAMA certificate levels

Requirement	Pearl Rating Achieved
All mandatory credits	1 Pearl
All mandatory credits + 55 credit points	2 Pearl
All mandatory credits + 75 credit points	3 Pearl
All mandatory credits + 100 credit points	4 Pearl
All mandatory credits + 125 credit points	5 Pearl

Source: (Council, 2010).

iv.   QSAS CERTIFICATE LEVELS.

(Table 10) shows there are 6 certification levels in GSAS/QSAS. Level 1 being the minimum a project can achieve for passing the GSAS/QSAS assessment and Level 6 being the maximum for achieving the highest score in the GSAS/QSAS assessment.

Table 5.10. QSAS certificate levels

GSAS/QSAS Certification Levels	Cumulative Score (X)	QSAS Star Rating (★)
1	$0.00 \leq X \leq 0.50$	★
2	$0.50 < X \leq 1.00$	★★

3	1.00<X≤1.50	★★★
4	1.50<X≤2.00	★★★★
5	2.00<X≤2.50	★★★★★
6	2.50<X≤3.00	★★★★★★

Source: (development, 2012)

Each level has an equivalent range of cumulative scores, which translates to star rating for the project. The aim for all QSAS criteria and their associated measurements is to be performance-based and quantifiable on the scale of -1 to 3 (-1, 0, 1, 2, 3) or 0 to 3, depending on the criterion's level of impact. This implies that every criterion should be measured in terms of a predicted outcome of the proposed design, such as a predicted load in an impact category for the environment, the depletion rate of fossil energy, the consumption of potable water, or the addition to the overall cultural value of the urban environment. Using negative points allows criteria with greater impact to be emphasized and to achieve a higher level of building performance. In QSAS, -1 is a negative measure of "not acceptable", and 0 is a threshold for "acceptable" or is used in the case that the requirement is not applicable. The scores of 1 to 3 are levels of gradual improvements.

Each category and criterion has an associated weight based on its relative environmental, social, and economic impact. Once a score is assigned to each criterion in the assessment system, the values are multiplied by the weight and a cumulative final score is determined. QSAS consists of six certification levels to measure the project's impact. A building that obtains a final score below 0 does not meet the baseline and will be denied certification. Certification can only be achieved when the final score is greater than or equal to 0, earning a rating of 1, 2, 3, 4, 5, or 6 stars. The highest score a building can achieve is 3.0 and the highest certification level is 6 stars.

5.1.6 Main Categories Sub Issues: Similarties and Differences

1.   THE SUSTAINABLE SITE:

(Table 11) shows:

Table 5.11. The sustainable site

The Issues of each category **1.Sustainable Site**	LEED V4. System	Australia green star rating system	ESTIDAMA	QSAS
Construction Activity Pollution Prevention	●	○	○	○
Site Selection	●	○	○	○
Development Density & Community Connectivity	●	○	○	○
Brownfield Redevelopment	●	○	○	○
Alternative Transportation, Public Transportation Access	●	○	○	○
Alternative Transportation, Bicycle Storage & Changing Rooms	●	○	○	○
Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles	●	○	○	○

Alternative Transportation, Parking Capacity	●	○	○	○
Site Development, Protect or Restore Habitat	●	○	○	●
Site Development, Maximize Open Space	●	○	○	○
Storm water Design, Quantity Control	●	○	○	○
Heat Island Effect, Non-Roof	●	○	○	○
Heat Island Effect, Roof	●	○	○	●
Light Pollution Reduction	●	○	○	○
Ecological Value of Land	○	○	○	●
Land Preservation	○	○	○	●
Vegetation & Shading	○	○	○	●
Water Body Preservation	○	○	○	●
Desertification	○	○	○	●
Rainwater Runoff	○	○	○	●
Landscape Amenities	○	○	○	●
Vegetation	○	○	○	●
Mix use centre.	○	○	○	●
Walk ability	○	○	○	●

The similarities in the main issues of Sustainable site category are:

-heat island effect

-site development

The differences in the main issues of sustainable site category are:

I. **LEED** has added more additional issues in Site Category i.e. : Construction Activity Pollution Prevention, Site Selection, Development Density & Community Connectivity, Brownfield Redevelopment, Alternative Transportation, Public Transportation Access, Alternative Transportation, Bicycle Storage & Changing Rooms, Alternative Transportation, Low-Emitting & Fuel-Efficient Vehicles, Protect or Restore Habitat, Site Development, Maximize Open Space, Storm water Design, Quantity Control, Heat Island Effect, Non-Roof, Light Pollution Reduction, Green vehicles, access to quality transit, est.

II. **Australia** rating system: They don't have sustainable site.

III. **QSAS**: added more additional issues in site category which are: Ecological Value of Land, Ecological Value of Land, Land Preservation, Vegetation & Shading, Water Body Preservation, Desertification, Rainwater Runoff, Landscape Amenities, Vegetation, Mix use centre, Walk ability.

IV. **ESTIDAMA**

2. INDOOR ENVIRONMENTAL QUALITY (IQE)

Table 12: Concluded the indoor environment as follows:

Table 5.12. Indoor environmental quality

The Issues of each category **2.Indoor Environmental Quality**	LEED V4.2 System	Australia green star rating system	ESTIDAMA	QSAS
Minimum IAQ Performance	●	○	○	○
Environmental Tobacco Smoke (ETS) Control	●	○	○	○
Outdoor Air Delivery Monitoring	●		○	○
Construction IAQ Management Plan, Before Occupancy	●	○	○	●
Low-Emitting Materials, Adhesives & Sealants	●	○	○	○
Low-Emitting Materials, Paints & Coatings	●	○	○	○
Low-Emitting Materials, Carpet Systems	●	○	○	○
Low-Emitting Materials, Composite Wood & Agrifiber Products	●	○	○	○
Indoor Chemical & Pollutant Source Control	●	○	○	●
Controllability of Systems, Lighting	●	○	○	○
Controllability of Systems, Thermal Comfort	○	○		●
Thermal Comfort, Design	●	○	○	○
Thermal Comfort, Verification	●	○	○	○
Daylight & Views, Daylight 75% of Spaces	●		○	●
Daylight & Views, Views for 90% of Spaces	●	●	○	●
HVAC System	●	●	○	●
pollutants	○	●	○	○
Monitoring air temperature and quality and adjusting or calibrating as appropriate	○	●	○	○
Maximizing views to the exterior for all occupants	○	○	○	●
Providing for occupant comfort by minimizing glare	○	○	○	●
Controlling the amount of noise produced by or transferred from the building interior and exterior	○	○	○	●
Mechanical ventilation	○	○	○	●
Indoor Chemical & Pollutant Source Control	○	○	○	●
Views	○	○	○	●

Illumination Levels	○	○	○	●
Acoustic Quality	○	○	○	●
Daylight	○	○	○	●
Construction IAQ Management Plan, Before Occupancy	○	○	○	●

The similarities in the main issues of Indoor environment category are: Increased Ventilation Construction, Low-Emitting Materials, Composite Wood & Agrifiber Products, Daylight & Views, Daylight 75% of Spaces, Thermal Comfort and Verification.

The differences in the main issues of Indoor environment category are:

I.   LEED: has added more additional issues in Control indoor environment Category which are: Minimum IAQ Performance, Environmental Tobacco Smoke (ETS) Control, Outdoor Air Delivery Monitoring, Construction IAQ Management Plan, Before Occupancy, Indoor Chemical & Pollutant Source Control, Views, Illumination Levels, Acoustic Quality, Daylight, indoor construction plan, thermal comfort, quality views and acoustic performance.

II.   Australia: New additional points has been added which are essential for contemporary design on shopping malls, educational and office buildings: HVAC system and pollutants.

III.   ESTIDAMA: None.

IV.   QSAS: has added additional points which are: Monitoring air temperature and quality and adjusting or calibrating as appropriate, Maximizing views to the exterior for all occupants, Mechanical ventilation, Indoor Chemical & Pollutant Source Control, Illumination Levels, Acoustic Quality, Daylight.

3. ENERGY AND ATMOSPHERE:

The Table 13: Concluded that the Energy is as follows:

Table 5.13. Energy and atmosphere

The Issues of each category **2-Energy and Atmosphere**	LEED V4	Australia green star rating system	ESTIDAMA	QSAS
Fundamental Commissioning of the Building Energy Systems	●	○	○	○
Minimum Energy Performance	●	○	○	○
Fundamental Refrigerant Management	●	○	○	○
Optimize Energy Performance	●	●	○	○
On-Site Renewable Energy	●	●	●	○
Enhanced Commissioning	●	○	○	○
Measurement & Verification	●	●	○	○

Green Power	●	●	○	○
HVAC Controls	○	●	○	○
HVAC System Simulations	○	●	○	○
Building Envelope	○	●	○	○
A/C Pumping	○	●	○	○
Modelling Information	○	●	○	○
Community Energy Strategy	○	○	●	○
Building Energy Guidelines	○	○	●	○
Energy Monitoring and Reporting	○	○	●	○
Community Strategies for Passive Cooling	○	○	●	○
Efficient Infrastructure: District Cooling	○	○	●	○
Efficient Infrastructure: Smart Grid Technology	○	○	●	○
Renewable Energy: Offsite	○	○	●	○
Energy Efficient Buildings	○	○	●	
Energy Demand Performance	○	○	○	●
Energy Delivery Performance	○	○	○	●
Fossil Fuel Conservation	○	○	○	●
CO_2 Emissions	○	○	○	●
NOX, SOX, & Particulate Matter	○	○	○	●

The similarities in the main issues of Energy category are: Optimize Energy Performance, On-Site Renewable Energy, and Measurement & Verification Green Power.

The differences in the main issues of Energy category are:

I.   LEED: added more additional issues in Energy and Atmosphere Category which are:

Commissioning of the Building Energy Systems, Minimum Energy Performance, Fundamental Refrigerant Management, Optimize Energy Performance, energy metering, enhance commissioning, renewable energy, green power, refrigerant management.

II.   Australia: added new additional issues which are essential on contemporary design on shopping malls, educational and office buildings: HVAC system, HVAC System Simulations, Building Envelope, A/C Pumping, Modelling Information.

III.   ESTIDAMA: added new additional issues in Energy and Atmosphere Category which are: Community Energy Strategy, Building Energy Guidelines, Energy Monitoring and Reporting, Community Strategies for Passive Cooling, Efficient Infrastructure: District Cooling, Efficient Infrastructure: Smart Grid Technology, Renewable Energy: Offsite, Energy Efficient Buildings.

IV.   QSAS: added additional issues in Energy which are: Energy Demand Performance, Energy Delivery Performance, Fossil Fuel Conservation, Fossil Fuel Conservation, CO_2 Emissions, NOX, SOX, & Particulate Matter.

4. WATER EFFICIENCY:

(Table 14): Concluded the water efficiency as follows:

Table 5.14. The water efficiency

The Issues of each category **4-Water**	LEED V4. System	Australia green star rating system	ESTIDAMA	QSAS
Water Efficient Landscaping, Reduce by 50%	●	○	●	○
Water Efficient Landscaping, No Potable Use or No Irrigation	●	○	●	○
Innovative Wastewater Technologies	●	○	○	○
Water Use Reduction, 20% Reduction	●	○	●	○
Water Use Reduction, 30% Reduction	●	○	○	○
Solar collectors	○	●	○	○
Hot water rating load	○	●	○	○
Measurements	○	●	○	○
water reuse	○	●	○	○
Community Water Strategy	○	○	●	○
Building Water Guidelines	○	○	●	○
Water Monitoring & Leak Detection	●	○	●	○
Community Water Use Reduction	●	○	●	○

	LEED	Australia	ESTIDAMA	QSAS
Community Water Use Reduction: Heat Rejection	●	○	●	○
Community Water Use Reduction: Water Features	○	○	●	○
Storm water Management	○	○	●	○
Water Efficient Buildings & Plots	○	○	●	○
Water Consumption	○	○	○	●

The similarities in the main issues of water category are: Water Efficient Landscaping, Water Use Reduction**.**

The differences in the main issues of water category are:

I. LEED: added more additional issues for water category which are: Innovative Wastewater Technologies., outdoor water reduction, indoor water reduction, water metering, and cooling tower.

II. Australia: added new additional issues which are: Solar collectors, Hot water rating load, Measurements, water reuse.

III. ESTIDAMA: added new additional issues in water which are: Community Water Strategy, Building Water Guidelines, Water Monitoring & Leak Detection, and Community Water Use Reduction Community Water Use Reduction: Water Features, Storm water Management, Water Efficient Buildings & Plots.

IV. QSAS: added additional issue in water, which is Water Consumption.

5. MATERIALS:

Table 15: Concluded that the materials are as follows:

Table 5.15. The materials

The Issues of each category **2-materials**	LEED V4.	Australia green star rating system	ESTIDAMA	QSAS
Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	●	○	○	○
Building Reuse, Maintain 95% of Existing Walls, Floors & Roof	●	○	○	○
Building Reuse, Maintain 50% of Interior Non-Structural Elements				
Construction Waste Management, Divert 50% from Disposal	●	○	○	○

Construction Waste Management, Divert 75% from Disposal	●	●	○	○
Materials Reuse, 5%	●	●	○	○
Materials Reuse, 10%	●	○	○	○
Recycled Content, 10% (post-consumer + ½ pre-consumer)	●	○	●	○
Recycled Content, 20% (post-consumer + ½ pre-consumer)	●	●	●	●
Regional Materials, 20% Extracted, Processed & Manufactured Regionally	●	○	●	●
Rapidly Renewable Materials	●	○	○	○
Certified Wood	●	○	○	○
Basic Construction Waste Management	○	○	○	○
Reused or Certified Timber	○	○	○	○
Improved Construction Waste Management	○	○	○	○
Improved Operational Waste Management	○	○	○	○
Organic Waste Management	○	○	○	○
Hazardous Waste Management	○	○	○	○
Life Cycle Assessment (LCA)	●	○	○	○
Eco Content	○	○	○	○
Durability	○	○	○	○
Environmental management system	●	○	○	○
Product stewardship	○	○	○	○
Storage for recycling materials	●	○	○	○

The similarities in the main issues of material category are:
Construction Waste Management, Materials Reuse, Recycled Content, Regional Materials, Certified Wood., **and The differences in the main issues of material categories are:**

I.   LEED v4: added more additional issues for material categories which are:

Building Reuse, maintain 75% of Existing Walls, Floors & Roof, and Building Reuse, Maintain 95% of Existing Walls, Floors & Roof, Rapidly Renewable Materials, storage recycling, LCA, waste management, and raw materials. Construction waste management planning, building life cycle analysis, environmental products, use of raw materials, Australia rating system added.

II. Australia: added more additional issues for material categories, which are: Eco content, durability, environmental management system, product stewardship (reuse-recycle-repressing) and Modular design.

III. ESTIDAMA: They add new additional issues in material, which are: Basic Construction Waste Management, Reused or Certified Timber, Improved Operational Waste Management, Organic Waste Management, Hazardous Waste Management.

QSAS: added material recycling and material reuse.

6. CONCLUSION OF THE COMMON CATEGORIES

The common categories between the four systems are sustainable site, indoor environmental quality, material, water and energy and Innovation in design

The main categories of LEED V4 are: Site location (16 points), Sustainable site (10 points), indoor environmental quality (16 points), the energy (33points), the water (11 points), the material (13 points) and the innovation. The assessment method is based on each category has identified weighing (6 points), regional priority (4 points). Then the total numbers of points are 110 points.

The building certified as: Certified: 20-46, Silver.50-59 points, Gold: 60-79 points, Platinum: 80-and above

Positive point of LEED's system that it has been a system developed since 2000 through 2013 and has been reviewed four times, where we now find LEED 2009, LEED V3 and LEED V4, and from time to time is announced in USGBC.org website of United state Green Building Council for members who are interested to share their experience to develop LEED process it takes about six months review1 and review 2 and review3 they listen to experts, professionals and users views towards improvement of the negative notes into possible positive issues.

In LEED v3 the sustainable site increased from 14 points to 26 points, more challenges were added, such as development density and community connectivity (5 points), alternative transportation(12 max), storm water design (2max) and site development up to 2 points.

In Water efficiency, water use reduction has been increased from 5 points to 10 points and adding water efficient landscaping (4max), innovation wastewater technologies up to 2 points and water use reduction up to 4 points max.

In energy the total points increased from 17 points to 35 points while concentrating on optimize energy performance (19 points max), on site renewable energy (7max), enhanced refrigerant management (2 points), measurement and verification (3max) and green power 2 points.

In materials the total points is increased from 13 points to 14 points, the total points are increased from I point to 2 points in material reuse up to 2 points

In indoor environmental quality, the total points were not increased; they are still on 15 points levels.

Innovation increased from 5 points to 6 points.

(Haselbach, 2008), presented an introduction to sustainable construction and discussed LEED system and principles. (Council, 1996), discussed the environmentally sustainable development main issues.

In addition LEED released LEEDV4 in July 2013, (Malin, 2013) discussed, in their report ,the new concept in LEED v4 and stated that LEED V4 has added integrative design process, Rain water management in Sustainable site category, LEED V4 provided Light pollution reduction; and in addition they have added Building envelop commissioning, Green Power and carbon offsets, as well as adding the whole building life cycle assessment, biomass raw materials, response to Mining, Health product, Measuring of VOCs. In Indoor Environment, special day light autonomy, acoustic performance, all these points were added to LEED V4 after fifth public comments through the period 10, 2012 to fall of 2013.

From this analysis we have concluded that the rating system is a developed system which improvement depends on the best practice from users and experts. In each version we have more challenges, and the total points are increased to achieve a higher certificate

As well, it contains sub issues that help in managing certain local and global problems, for example the local problems i.e. : storm water design in Sustainable site category; and examples for global problems that have an effect on the local environment heat island effect, smoke control and optimize energy performance.

5.1.7 The Additional Categories Was Added by the Global Assessment Methods

LEED: added regional priority, Innovation and Site location

Australia green star system provides new additional categories which are:

Management Credits addressed the adoption of sustainable development principles from project conception through design, construction, commissioning, tuning and operation:

Transportation Credits reward the reduction of demand for individual cars by both discouraging car commuting and encouraging use of alternative transportation

Land ecology: Credits address a project's impact on its immediate ecosystem, by discouraging degradation and encouraging restoration of flora and fauna.

ESTIDAMA: Urban community, integrated development process, Natural System.

Urban Community consist of : Plan 2030, Urban Systems Assessment, Provision of Amenities and Facilities, Outdoor Thermal Comfort Strategy, Minimum Pearl Rated Buildings Within Communities, Transit Supportive Practices, Neighbourhood Connectivity, Open Space Network, Accessible Community Facilities, Housing Diversity, Community Walk ability, Active Urban Environments, Travel Plan, Improved Outdoor Thermal Comfort, Regionally Responsive Planning, Pearl Rated Buildings Within Communities, Safe and Secure Community.

Integrated development process consists of:

Integrated Development Strategy, Sustainable Building Guidelines, Community-Dedicated Infrastructure Basic Commissioning, Life Cycle Costing, Guest Worker Accommodation, Construction Environmental Management, Sustainability Awareness.

Natural System consists of:

Natural Systems Design and Management Strategy Reuse of Land, Remediation of Contaminated Land, Ecological Enhancement, Habitat Creation and Restoration, Food Systems.

QSAS: Urban Community, Culture and economic value.

Urban Community consists of:

Proximity to Infrastructure, Transportation Load, Load on Local Traffic Conditions, Solid Waste **Load, Pedestrian Pathways and Wastewater Load**

Culture and economic value:

The building's cultural and economic values shall be maintained or enhanced

v. Encouraging designs to align with cultural identity and traditions

vi. Designing for seamless integration into the existing cultural fabric

vii. Planning for the use of local materials and workforce

viii. Encouraging sustainable business partnerships within the community

ix. Constructing a diverse mix of housing typologies

x. These new categories have been added to satisfy the need for connecting the design with local culture, economic and local community and local environment.

5.5.1.8 Availability

Availability needs to be usable on all of its project and building types. All the Global systems in this comparison are applicable in many of buildings type. See (Table 16) which **concludes the availability as follows.**

Table 5.16. The availability of each system

The System	New construction	Existing building	Shell core	Commercial	retail	schools	homes	Neighbourhood Development	Healthcare	education	office	industrial	Mix use	Residential	Mosque	Hotel	Operation	sport	warehouses
LEED V.4	●	●	●	●	●	●	●	●	●	○	○	○	○	●	○	○	○	○	●
GBCA	●	○			●		●		●	●	●	●							
ESTIDAMA		○			●	●			●				●	●					

QS											
AS	●		●	●		●		●		●	●	●	●	●

LEED: Applicable to new construction, existing buildings, commercial buildings, schools, neighbourhood, and healthcare. Warehouses, hospitals, data centres, mid-rise residential.

GBCA: Applicable to new construction, healthcare and education.

ESTIDAMA: new construction, schools, mix use, residential and retails

QSAS: new construction, commercial buildings, homes, schools, neighbourhood, residential, mosque, hotel, operation and sport.

5.5.1.9 Applicability

Since when is this system applicable?

Table 17 discusses the applicability of each system as follows:

Table 5.17. The applicability of each system

Applicability	LEED V4.	Australia green star rating system	ESTIDAMA	QSAS
	●	●		●	●

LEED: applicable since the year 2000 and they stated with LEED V1 on 2006, LEED V.2 in 2007, LEED V3 latest 2010 and LEED V4 latest 2012.

Australia: Applicable since 2008

ESTIDAMA: Applicable since 2009

QSAS: Applicable since 2009

5.1.10 Development

The study of the method of development will be carried out through Government, Private, Industry, NGO and Experts Opinion.

Table 18 shows the development of each system as follows:

Table 5.18. The development of the each system

Development	LEED V4.	Australia green star rating system	ESTIDAMA	QSAS
Government	●	●	●	●
private	●	●	●	●
industry	●	●	●	●
NGOs	●	●	●	●
Expert opinion	●	●	●	●

LEED: developed by the U.S. Green Building Council member committees. The U.S. Green Building Council is a non-profit organization.

GBCA: developed by GBCA.

ESTIDAM: developed by Abu Dhabi Urban planning council.

QSAS: developed by Gulf Organization for research and development. subsidiary of QATARI DIAR Real Estate Investment Company) - is a fully governmental Organization located at the Qatar Science and Technology Park (QSTP); which objective is to promote healthy, energy & resources efficiency, and environmentally responsible building practices in Qatar and the entire Gulf region.

5.1.11 Durability

The life cycle analysis is provided or not?

(Table 19) shows the durability of each system through LCA

Table 5.19. The durability of the system

Durability	LEED System	V4. Australia green star rating system		ESTIDAMA	QSAS
LCA	Applicable	N/A		N/A	N/A

(Roaf, 2001) defined the life cycle analysis as:

"*Life cycle analysis: It is used as a way of assessing the total impact of any building and shows the importance of the building's lifespan. The longer a house can last, the lower the impact of the energy and pollution resulting from the manufacture of its materials will be. A simple way to think about this is to consider the initial embodied energy of an entire building and divide this figure over its lifetime, making an allowance for maintenance*".

We should provide the LCA for each material, products and manufacturer's warranty.

Eco building materials are preferred, recycling materials, re-use, re-processing.

I.   **LEED**: LCA is applied to LEED V4, in manufacture of building materials

and equipment, recycling/ reuse process.

II.   **Australia**: LCA not applicable

III.   **ESTIDAMA:** LCA not applicable

IV.   **QSAS:** not applied LCA.

PART II: IN DISCUSSION AND ANALYSIS

5.5.2 Additional Categories from Researcher Point of View for Hot Dry Climate

5.5.2.1 The Location and the Environmental Issues

The second part of the study introduces additional categories suitable for hot dry climate; which are not presented by the four global systems. The location of the case study carried out in Greater Khartoum city, which consists of the three towns, the capital Khartoum, Khartoum North city and Omdurman city. It is located between latitude 15° 36' north and longitude 32° 3 east, with an altitude of 380 meters above sea level.

The climate described as hot dry climate, the temperature in summer ranges between 40°C to 45°C, in winter it drops to 14°C to 25°C. rainfall ranges between 100mm to 150-mm. Relative humidity is 40% to 60%. of Greater Khartoum area is experiencing floods, desertification and rare earthquakes. Wide variety of natural vegetation's covers the surrounding lands of the River Nile.

5.5.2.2 Health Safety and Emission

None of the four Global Rating Systems provides health safety and emission as important Category.

Health safety and emission are the most important categories to be added and therefore, healthy houses, minimized emission of CO^2, and use of nontoxic building materials, should be provided to ensure secure building safety procedures. Focusing on the direct application of techniques and strategies that advance the concept of sustainable design, as defined above. All these topics deal with or affect the health, safety, and welfare of the public and the communities at large.

Health

Roof, S., Fuentes M. and Thomas (2001) S. Op cit, discussed human health, asbestosis, asthma, and allergic skin reactions to asbestos exposure, nontoxic building material and provision of impervious dust screen.

Safety procedure

(Pank, 2002) discussed safety procedures in building sector like: Enhancement of earthquakes resistance and adoption of Fire Safety Engineering. Fire safety engineering is a relatively new discipline, which has developed in recent years especially, to meet fire control solutions in buildings that fall outside of the current codes such as large and complex buildings demonstrate that the proposed fire solutions meet or outperform the requirements of the intent of the regulations.

Building is Permanent Fire Brigade.

Although it is not mandatory, additional security measures have been adopted against fire accidents and have developed firefighting by stationing of firefighting crews in the UK, other European countries, such as Fraermanepntly stationed, within the building.

Phased Evacuation.

Protected escape routes in tall buildings must be managed effectively. To avoid excessively wide escape stairs, needed to evacuate several thousand people at the same time, phased evacuation is common. In this regard, the services within the building are shut down on the floor, where an alarm is raised together with one or two floors above and one floor below, and these floors are evacuated first. Fire protection of the building structure is related to evacuation times by a risk assessment approach - the longer the time for total evacuation of a building, the greater the provision for fire protection.

Fire Fighting Shafts and Lifts

For tall buildings, protected access within the building for firefighting can be provided by the design of firefighting shafts. Firefighting lifts are currently used for heights greater than 18m. .

Smoke Control

Staircase pressurization and smoke control systems are provided in fire rated airshafts. Smoke dampers activated by the Fire Alarm System are used in air conditioning and ventilation ducts.

Sprinkler Protection and Gas Flooding Systems

Sprinkler protection is provided throughout the building, as an automatic means of firefighting and controlling a fire during its initial growth. Gas flooding systems may be considered in specialist areas, such as computer data rooms, where sprinkler systems are undesirable.

Emissions

(Roaf, 2001) as well as, discussed gaseous emissions, in eco house we can avoid emissions by using exhaust fans, and clean energy in order to minimize CO_2 emissions by proper

ventilations. Carbon dioxide CO_2, carbon monoxide CO in breathing and combustion inside the house, they are sources of air pollution, and Chlorofluorocarbons (CFCS).

In insulates, aerosols, refrigerants and fire extinguishers are responsible for destroying the ozone layer above the Earth that shields the planet from incoming radiation. (Roaf, 2001) stated that we should avoid toxic building materials such as PVC and use eco building materials in paints and plaster.

5.2.3 The Outdoor Environment

QSAS added the outdoor environment as new category in their FINAL DRAFT QSAS QUIDE (development, 2012)**. ESTIDAMA provides outdoor thermal comfort strategy inside liveable community category.**

For Greater Khartoum it's very important to improve the outdoor thermal environment by controlling the design by providing shades to the building in North direction, South direction and enhance landscaping on sides with plants and trees that can provides more shades; fences protect the site from dust swimming pools and fountains modify the dry climate to humid climate. Khartoum residents take very much concern towards the outdoor environment where the climate is hot and dry. Khartoum residents spend part of their time, particularly nights times, in the gardens which are also enjoyed during holidays and celebrations.

Ecological.

(Lmdc, 2005) discussed thermal comfort in outdoor environment and said that: bringing people outdoors reduces demands for in indoor spaces and provides increased opportunities for contact with the natural world. Reduced demand on indoor spaces reduces indoor light and air conditioning energy requirements.

In order to improve their health, urban dwellers are required to increase their exercise activities and inhale more fresh air during daylight since they spend a large portion of their time staying indoors. As their contact with natural environment increases, their life-stress will be reduced, and more opportunities for rest and relaxation will be available to them. Creating opportunities for people to go outdoors and be in connection with nature will also arouse their awareness of these atmospheres and their role in sustaining them.

Economic

Increasing and extending the amount of time spent in comfortable outdoor spaces, provides increased and extended opportunities for outdoor retailing, dining have direct economic benefits in both, increased productivity and reduced medical costs.

Social

Outdoor spaces could enhance the level of social interaction that occurs in a neighbourhood. A comfortable outdoor space is likely to be utilized more frequently where increased presence of people outside boosts the security of the premises and contribute to deter crime.

5.2.3.1 Landscape and Buildings Work Together

(The Ministry of Environment, 2006) stated that perm culture adoption and application of organic techniques, rather than other techniques which could go against nature. The goal of permaculture is to create natural life supporting systems even in the smallest most urban areas. Healthier, more integrated environment results, when we combine the inherent qualities of plants and animals with the natural characteristics of landscapes and structure. (Shafiq, 2010) stated in his paper "Sustainability of Traditional and contemporary architecture' that uses of plants and trees reduce the cooling bill by 15-35% beside application of windows shades and sun screen from plants serve 10% of cooling system costs.

5.2.3.2 The Basic Understanding of Landscape Design and Its Elements

(Awad, 2007) discussed in a paper, "The elements of landscape or landscape architecture design" and said that these elements are divided into two main parts: plants and trees, space of air mass, buildings, civil and mechanical construction, elements of landscape, ecological features.

<u>Conclusion of Outdoor Environmental Control:</u>

- In Sudan it is very important to improve the outdoor environment and provide thermal control

- provide shades and terraces and balconies

- provide swimming pools

- provide fountains

- maximize the outdoor environment in view of its physiological, ecological and economical and social aspect as specified, in order to make the air more humid and comfortable.

5.2.4 The Building Form

None of the four Global systems Added Building Form as important Category.

We have different buildings forms, cubic form, linear form, L-form, U- form, circular forms. There are many factors that compel and urge us to prefer a particular form over the others:

- Building location, whether the building is located on a top of a mountain or on flat land, cold areas or wet or hot dry climate each location requires specific form.

- The climate: whether the building is located in hot climate zone or cold climate. In cold areas it is better to use cubic form while in hot climate its preferred to use L-form or U-form or leaner form, as they provide good ventilation.

- The sun position: it is very important to study the sun movement in a specific location in order to determine the building form and shape. The building form secures more shades and minimizes the solar radiation.

- The Heat exchanger: The greater the volume of the building the more exposed surface area it has to lose or gain heat, Roaf, S., Fuentes M. and Thomas, S. (2001) discussed the building form in several cases such as: building as an analogy, the Ice House, the tea cosy cottage, the green house , the nomadic tents and the igloo. Figure 1 shows that different plan forms can have more or less wall area for the same plan area.

- *The surface area: volume ratio* is very important in conserving heat transfer into and out of a building. To conserve heat or cold, the building must be designed with a compact form to reduce the efficiency of the building as a heat exchanger. Buildings can have very different perimeters: area ratios depending on their plan form. (See figure. 1).
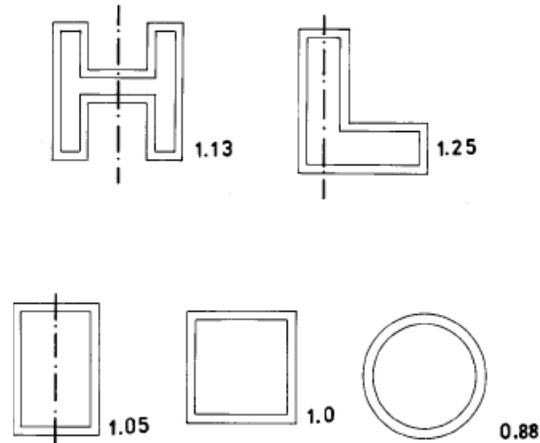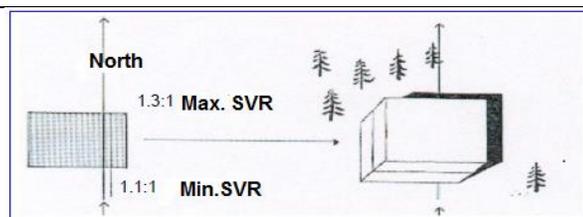
Figure 5.1. Buildings forms
Source: (Roaf, 2001).

- The building form also changes according to building function; we have found that linear form is suitable to schools, office buildings. The Cubic and U form is suitable to hospitals and circular form is suitable to exhibitions.

- Building information modelling (BIM) and energy simulation software are used to understand and predict the effect of building form on energy use for various design concepts in the early stages of the design.

- The orientation of the building should be perpendicular to the direction of the wind. It is worth to note that some experiments proved that greater velocities of the air could be obtained inside a building, if the orientation is kept at 45 degrees with the direction of the wind and offer more wind shaded area (Hassan, 2001) discussed the relation between building orientation and the wind direction and said that his good orientation of the building makes the house healthier, and by studying of sun rises and sun sets locations we shall be more knowledgeable of the direction of the shades made for the gardens and terraces.

- If we consider all the above mentioned criteria we can apply the sustainability and durability of the building.

The building form is developing through the history and people are always choosing the form suitable to their local environment and local climate. The nomadic tent shows a good example of an adaptable building form. (See Figure. 2) showing the buildings form and their orientation and surface volume Ratio.

| Cold Climate | |

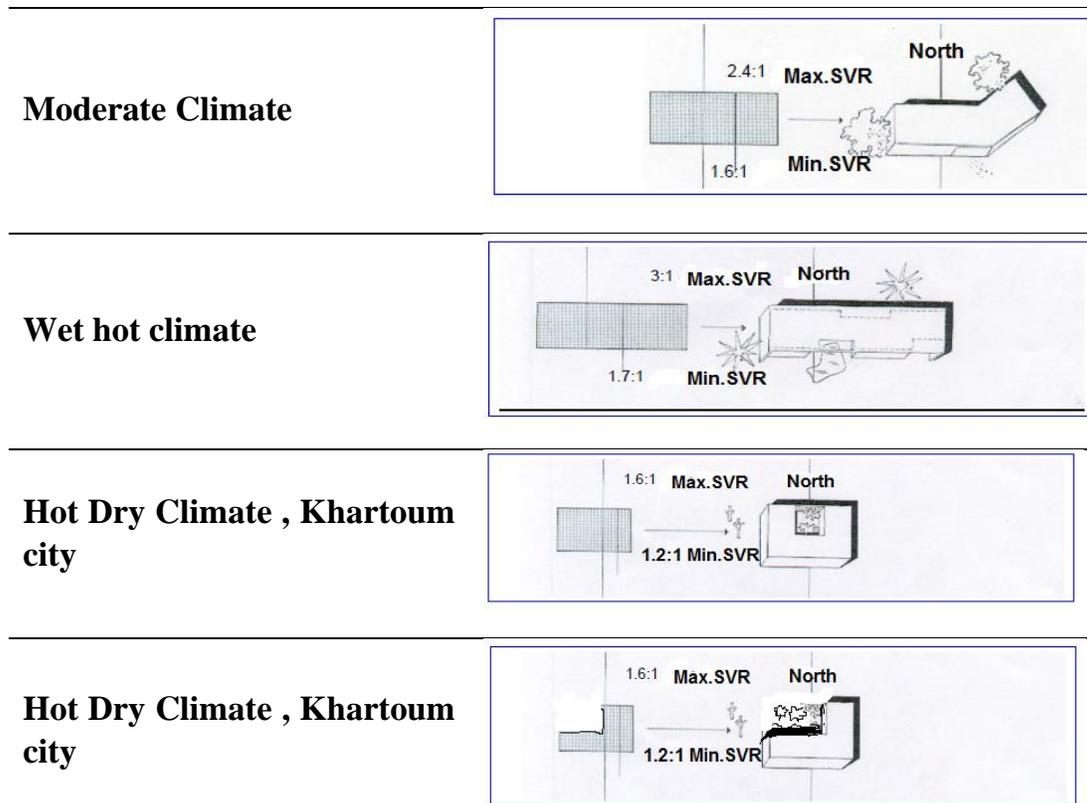|	
Moderate Climate	
Wet hot climate	
Hot Dry Climate , Khartoum city	
Hot Dry Climate , Khartoum city	

Figure 5.2. The Relation between building form and the surface volume ratio (SVR) and building orientation

Source: (water, 2012)

5.2.5 The Holism and Environmental Design Process

Holism

The term holism has been used to describe the view that a whole system must be considered, rather than simply its individual components. The Vales have addressed this point in their book Green Architecture, suggesting that a building should attempt to address all of the principles of green design in a holistic manner (Vale and Vale, 1991). Holism emphasizes the relationship between the parts and the whole. Another dimension of holism comes from an engineering perspective and relates to the synergy between systems, which is a critical part of the physicality of a house. Holism can mean the way in which systems are integrated within the home – for example, the way, in which the solar system is integrated with the roof or, the water recycling system is integrated with the irrigation system. In summary, the outcome of holism can create and lead to greater improvements in environmental performance. (Hide, 2008)

Identify of the whole design process from the design initial stages and the design pass through three phases:

Pre-Building Phase:

Prebuilding phase is the design phase, primary, developed and final design. Adoption of sustainable eco-building categories to be as main goals.

Building phase:

Building phase is in construction and operation system, in this level, dealing with contractors and suppliers apply appropriate technologies in mechanical system and construction waste disposal and control of noise in site.

Post Building Phase:

After building construction has been completed come the users' role who should observe regular maintenance of the building, to ensure building long life and durability and improve of the Rating System through regular reviews by stakeholders and frequent survey by the users of the system in order to maintain and manage the difficulties.

Acknowledgement

References

Alhor, Y. (2009). *Development of comprehensive Sustainability Rating System in Qatar (QSAS).* Qatar, BQDR, Qatar ..

Australia, G. B. C. O. (2016). *Green Building Council Of Australia.* Retrieved September 30, 2015, from www.g.b.c.a.

Awad, A. (2007). *Towards an Understanding of the Role of Landscape Design.* Khartoum, Sudan, Rethinking our Design Conference, Faculty of Architecture, University of Khartoum .

City, M. (2011). *The Future Built.* Retrieved September 30, 2015, from http://www.thefuturebuild.com/leed/page.htm

Council, A. D. P. (2010). *Pearl Community Rating System Design & Construction Version 1.* ESTIDAMA Abu Dahabi Urban Planing Council ed. Abu Dhabi : Abu Dahabi Planning Council, UAE.

Council, A. D. U. P. (2016). *Abu Dhabi Urban Planning Council.* Retrieved September 30, 2015, from http://www.upc.gov.ae/home.aspx?lang=en-US

Council, E. G. B. (2007). *Emirates Green Building Council.* Retrieved September 30, 2015, from www.emirates.gbc.org

Council, S. A. G. B. (2013). *South Africa Green Building Council.* Retrieved from http://www.gbcsa.org

Council, U. S. G. B. (1996a). *Sustainable Building Technical Manual", Green Building Design Construction and Operation.* USGBC ed. USA: Public Technology Inc. U.S.A..

Council, U. S. G. B. (1996b). sustainable building technical manual, green building design and operation. In D. Gottfried (Ed.), *green building design and operation* (pp. 20). U.S.A: Public Technology Inc.

Council, U. S. G. B. (2016). *United State Green Building Council.* Retrieved from http:www.usgbc.org

Development, G. O. O. R. A. (2012). *QSAS Technical Guide ,* Qatar : QSAS.

Diar, Q. (2010). *Developing a sustainablity rating system in GCC the Experience from Qater.* Riyadh, Saudi Green Building Forum, Riyadh City, KSA.

Fenner, R. A. R. T. (2008). *A Comparative Analysis of two Building Systems.* Canada, Engineering Sustainability, 161.

Fowler, K. A. R. E. (2006). *Sustainable Building Rating Systems Summery.* USA: US Department of Energy.

Haapio, A. A. V. P. (2007). *A Critical Review of Building Environmental assessment tools.* TKK, Finland, ELSEVIER.

Haselbach. L. (2008a). *The Engineering Guide to LEED New Construction* (Mac Craw Hill ed.). New York: Mac Craw Hill Press.

Haselbach, L. (2008b). *The Engineering Guide to LEED New Construction* (1st ed.). New York: Mc Craw Hill Press.

Hassan, S. (2001). *The Principles of Environmental Urban Science.* Khartoum, Sudan, 1 st, Sudan for Science and Technology University.

Hide, R. (2008). *Bioclimatic Housing inovateive Design For warm climates* (1st ed.). UK: Cromwell Press.

Lmdc, P. A. N. (2005). *Outdoor Environmental Comfort, Sustainable Design Guidelines Refrence Manual.* UK: WTC redevelopment Projects, Croxton Collaborative Architects, PC.

Malin, N. A. M. P. A. R. T. (2013). *New Concepts in LEED V4 ,* USA: Building Green Inc.

Ministry for Environment, H. C. C. a. A. R. C. (2006). *Easy Guide to Eco Building Design and Live with the environment* (1st ed.). USA: BRANZE Press.

Pank, W. G. H. a. C. G. (2002). *Tall Buildings and Sustainability, Corporation of London.* UK: Corporation of London.

QSAS. (2016). *Qatar sustainability assessment system.* Retrieved from www.qsas.org

Rick, A. (2012). *The Architecture of Green Building Designing State of the Sustainable Structure for the Middle East Environment Culture and Heritage.* KSA, 3 rd Saudi Green Building Forum .

Roaf, S. F. M. a. T. S. (2001). *Eco House A Design Guide.* Architectural Press ed. UK: Architectural Press.

Shafiq, J. (2010). *Sustainability of Traditional and Contemporary Architecture.* KSA, Riyadh city, Conference on Technology and Sustainability in the Built Environment , King Saud University .

Steemers, K. a. S. M. (2004). *Environmental Diversity in Architecture* (1st ed.). UK: Spoon Press.

Thaimosy, M. a. F. M. S. S. H. P. (2006). *A Comparision of The LEED and Geen Globes System.* CANADA, The Carpenters Industerial Council (CIC).

Thomas, R. a. M. F. (2006). *Environmental Design An Introduction for Architects and Engineer* (2nd ed.). USA: Taylor & Francis Group.

UNEP. (2012). *21 Issues for the 21st Century,* USA , www. ECo Builders : UNEP Eco Cities Emerging Magazine.

WAN, Y. (2014). *Analysis of the International Sustainable building Rating System for Sustainable Development with special focused on Green Building Index Malysia (GBI).* Malaysia, Faculty of Technology and Management .

Water, T. M. o. E. a. (2012). *Rationalization Guide book.* KSA, Riyadh City, The Ministry of Electricity and water.