

# **Guidelines for Integrating BIM Thinking Process into the Egyptian Design Studios in Architecture Schools**

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## **Abstract:**

Building Information Modelling (BIM) is now becoming a widespread all over the world. In Egypt, starting from the mid 2000's, BIM was introduced as a new technology that eases the opportunity of collaborating and sharing information through intelligent modelling in the Architectural, Engineering and Construction (AEC) industry. Going in depth into the Architectural design education in universities, undergraduate students lack understanding BIM knowledge, practice and process application throughout their academic years till graduation. Thus, this research aims to conclude guidelines for integrating BIM as a process into the design studios for the next architecture students' generation. These guidelines may enhance the architecture design process through BIM thinking process. Students would further graduate as BIM-Based to meet the career requirements needed after graduation. BIM and its process will be focused in an in-depth literature review in addition to discussing the traditional architecture design process in design studios. International case studies will address the universities' experiences upon BIM's integration in the design studios. Finally, questionnaires were held amongst students to identify their perception upon the integration of BIM as a process. To conclude, a comparison between both the traditional design process and the BIM process in design will be deducted to accomplish BIM integration guidelines into architecture the design studios.

**Keywords:** Building Information Modelling, BIM process, Architecture design process, design studios, Egypt.

## **Introduction**

BIM which is known as Building Information Modelling has become one of the most popping trends in the architecture, engineering, and construction (AEC) industries, (Eastman et al., 2011). Juan Rodriguez, a professional civil engineer reported that BIM is the practice of creating and representing a 3D building including gathered data during its development (2018). Most of the people understand BIM just as a technology change; however, they don't keep in mind that is also a process change (Eastman et al., 2011). Moreover, this intelligent process is for creating and handling information on a construction project across the project's lifecycle through corresponding phases. Building information modeling furthermore emphasizes the importance of a contributing environment; all team members are involved together through one project (NBS, 2016.)

Focusing onto the architectural major in universities, BIM Education is the method of gathering both the conceptual and practical knowledge through integrating the BIM process in the way of learning. BIM process in the design studios improves the collaboration between project participants of any other disciplines throughout the project's cycle. Furthermore, BIM process thinking empowers both current and future architecture generations to cope with the advanced technologies awaiting them (Succar et al., 2012). This topic has been introduced prior in Universities from different international countries

such as the USA, the United Kingdom and Australia, France, Germany, China, Japan, etc. (Lee et al., 2014; Paul, 2018; Wong et al., 2011). In the Egyptian universities, architecture major mainly focused onto educating students BIM tools, software, and its broad basics. However, the concept of spreading BIM process into the architectural design studios is not common in most of the universities. Thus, graduates do not meet the requirements of many

firms that are using BIM process nowadays. This creates a gap between architectural education in the design studios and working on projects within a BIM context. Using BIM as a pedagogical process bridges the gap between educators and the awaiting career by understanding the required concepts and skills pertaining BIM in the design process. Hence, this research aims to develop guidelines for the integration of BIM in the architectural design studios taking into considerations the challenges that would face this process in order to succeed

## Definition and History of BIM

BIM has been defined differently by Architectural, Engineering and Construction (AEC) professionals and researchers conferring to their interpretations and perspectives. According to the national institute of building sciences (NBIS), BIM is defined as a digital representation of both physical and functional features of a facility through sharing information knowledge resources to it (NBIS, 2019). Autodesk software company has also stated the term “Building Information Modelling (BIM)” as an intelligent process that gives all AEC authorities the tools to professionally plan, design, construct, and manage buildings or infrastructures through a 3D illustrating model (2019).

“If anyone deserves the title “father of BIM,” surely it is Chuck Eastman” stated Jerry Laiserin labeling himself by the “Godfather of BIM” (Eastman et al.,2007, p. xiii). In 1974, Charles M Eastern known as Chuck, criticized the hardcopy drawings since they fail in representing the building as the renovations occur to any project,

yet drawings don’t get updated. This made him in 1975 introduce a new working prototype called Building Description System (BDS) in a paper “The Use of Computers Instead of Drawings in Building Design” that allows 2D drawings to be derived from models and eases the clashes detection. BDS had its own elements library that was limited as well as the potential design choices according to the architectural, structural and energy aspects (Eastman, 1975). Many more advanced programs have been created before the launch of Autodesk with their product AutoCAD. In 2000, a first version of Revit was created by a start-up company called Charles River Software. However, in 2002, Autodesk has purchased the company in order to promote the program. Revit moreover, has become a revolutionary platform all over the world creating a paradigm shift for the architectural, engineering, and construction industry through BIM (Bergin, 2011). The following figure briefs the history timeline of BIM:

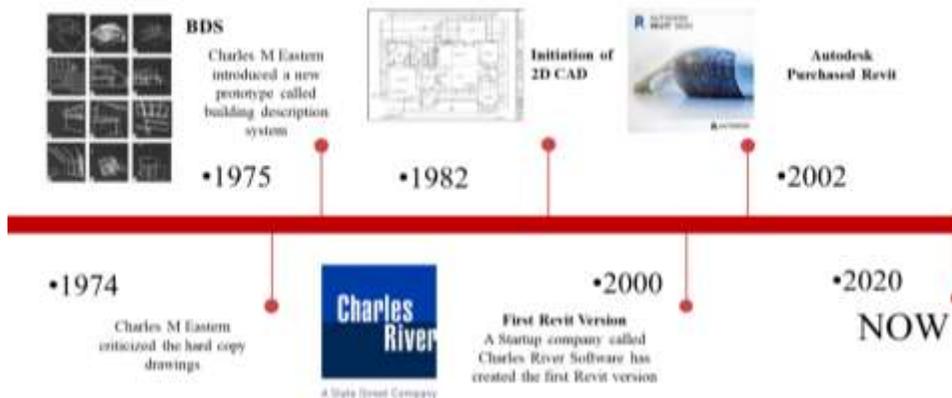


fig. 2 BIM History Timeline (By Author<sup>a</sup>,2019)

### 1. BIM Dimensions

According to Richard McPartland, BIM Dimensions is the way in which different kinds and amount of data are applied into a 3D model (2017). This aids in understanding the levels of

information added to every project given. In this research, the focus is only onto the first, second and third dimensions of BIM. However, these dimensions start from 1D till 7D as follows. The

first dimension is called the scratch point level, where it is the early stage of any design project when concepts and ideas are generated through gathering information related to the site, project type etc. ("BIM DIMENSIONS - Common Data Environment", n.d.). The second dimension is sorted on developing all the conceptual designs into 2 dimensional plans, to export afterwards sections elevations and even the working and detailed drawings. ("BIM DIMENSIONS - Common Data Environment", n.d.). BIM is mostly familiar with the third dimension as it

visualizes out the model required in the design process. The 3D graphical representation helps to detect the conflicts that may occur through the 2-Dimensional phase. (McPartland, 2017). The fourth, fifth, sixth and seventh dimensions come afterwards as they resemble time information added, cost estimation, sustainability and facility management respectively. (Carpenter-Beck, 2017; McPartland, 2017). This research would mainly focus onto the first three dimensions of BIM as they are the main dimensions integrated within the architecture design studio process.

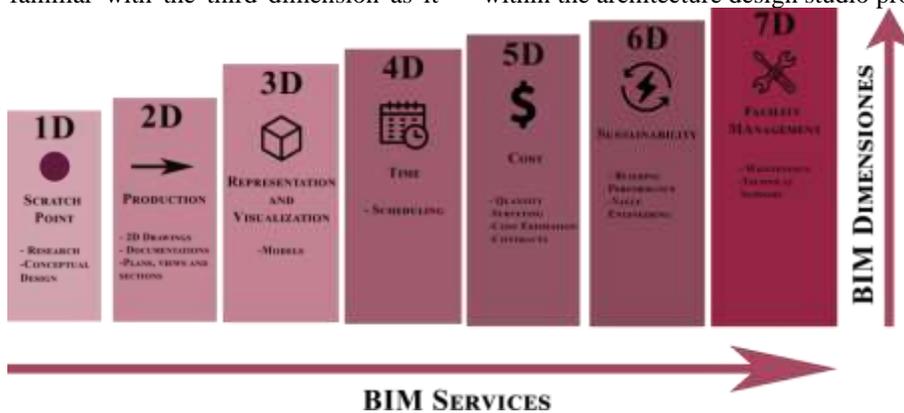


fig. 3 BIM Dimensions (By Author<sup>a</sup>,2019)

## 2. Key Factors of BIM:

Taking that one step further, BIM requires three main factors in order to accomplish an effective and successful platform as shown in fig. 2 which are categorized to tools (technology), behaviors,

and lastly process. Without these three crucial key aspects BIM workflow would not function properly. These are BIM as a tool, BIM as behavior, and BIM as a process.

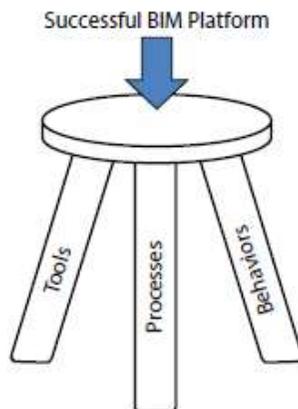


fig. 4 Key factors of BIM (Hardin et al., 2015)

### **2.1. BIM as a Tool**

The successful integration of BIM takes place through using working tools that are based on technology. Hence, a major amount of software have been growing up that each is classified according to its type. BIM technology eases concurrent work by multiple design disciplines. Though collaborating with drawings is still possible, however inheriting this is more problematic and consumes a lot of time rather than working with more than coordinated 3D models that can be controllable. Merging with BIM technology shortens the design time and decreases the occurrence of errors. It also provides earlier awareness into design problems and gives chances for further improvements.

New technologies of BIM provide visualization, accuracy of cost estimation through quantity surveying of materials, area of spaces, etc. in order to conclude bill of quantities extractions that are beneficial in the early stages of design before the progression in the construction. Building Information Modelling links energy analysis tools that evaluate the energy efficiency, simulates models and tests the sustainable aspects required which is not practical through using 2 dimensional drawings and tools. Thus, reduces the no of modifications needed to improve the building's performance (Eastman et al., 2011).

### **2.2. BIM as a Behavior**

In order to achieve a successful BIM environment, users' behaviors should change. Attitudes influence the behavioral intention of BIM adoption. BIM is not about being a technological process and software but also a

mindset changes of how individuals collaborate in teams. This could perfectly be reflected on the organizations' behaviors (Hardin & Maccol, 2015).

### **2.3. BIM as a Process**

There is a common misconception that building information modelling is all about creating a 3-dimensional model; however, BIM is observed as a virtual process that embraces all features, disciplines, and outlines of a design within a virtual model, which allows the parties to collaborate more accurately and efficiently than conventional old processes. When the model is being created, team members are able to edit, adjust and modify their tasks according to the project

requirements and design changes to ensure that the model is as accurate as possible and compatible with all needs before its approval to be executed and constructed on site. (Carmona & Irwin, 2007). BIM is a cycle that enhances collaboration between all the team members such as owners, architects, engineers, contractors, subcontractors and suppliers. (Kymmell, 2008).



fig. 5 Traditional process Vs. BIM Process (Young, 2008 cited in Foster,2009)

### 2.3.1. BIM Process Objectives

Building Information modeling sets its objectives in order to enhance the project's performance. It illustrates the main concepts of both the actions and interactions of the human being such as collaboration, communication,

visualization, and understanding. These four concepts are connected to one another such that for instance understanding can be achieved through collaboration, communication and visualization. (Kymmell, 2008)

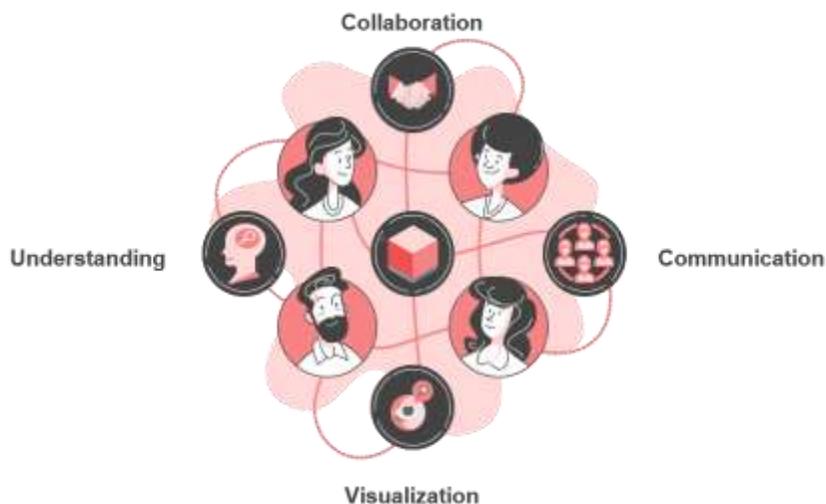


fig. 6 BIM Objectives (By Author<sup>a</sup>,2019)

Collaboration is a crucial aspect for BIM refers to the supportive action made by team members in order to achieve a successful design project. Students collaborate in a BIM environment synchronously on the same design (Eastman et al., 2008). BIM process is the ideal tool for helping team members to collaborate rather than compete. (Kymmell, 2008).

BIM moreover boosts the communication between the students and instructors and between the students themselves. The need for communication is basic at any university. In the design, quantity is not as important as the quality being served. Communicating with the team enhances collaboration and enhances the behavioral environment. (Kymmell, 2008). However, many communication problems may

occur due to the insufficient communicated design information cause from the wrong interpretation of the design. Converting concepts and sketches into 3D graphical models is a beneficial communicating way between students and their supervisors (Reddy, 2012). Visualization is BIM's main key feature in the architectural education. Creating a 3-dimensional model at any time and in any phase of the project helps in representing the design concept to be understandable to the instructors, team and other audience. (Reddy, 2012). Visualization can enhance the communication between students, and as a result it creates a better understanding environment for them. The students can understand the project's needs, the ideas behind BIM process and its concepts (Reddy, 2012).

### 3. Architecture Design Process

Architectural design process is known as the process of problem solving that ends up with adding value as illustrated in fig. 5. Architecture students are required to express their solutions as a form of buildings. The architectural design process is considered one of the utmost interesting processes especially when it is

focused on university students. It is a bit challenging as students expect to receive the right knowledge, understand what real architecture is and to develop their design skills. According to Osman, the design studio is the core of the architectural learning process (2001).

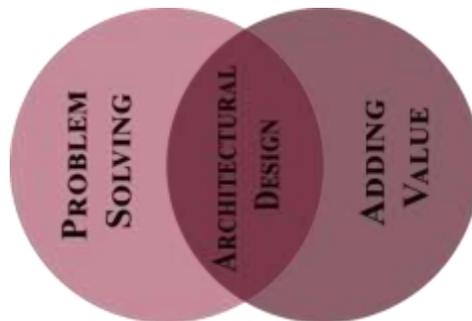


fig. 7 Architecture Design Process (By Author<sup>a</sup>,2019)



fig. 8 Architecture Design Process and stages (By Author<sup>a</sup>, 2020)

This keeps the traditional process of design in the design studios the most common teaching process amongst universities worldwide. The design process can be mainly classified into 6 stages:

1. Define the Problem: Architecture design is considered a problem that demands the student to come out with a solution expressed in a form of a building. A solution could not be achieved unless the student has a clear idea what the problem is.

2. Collect Information: This phase is the research phase of any design project. This research can vary according to the demands of the instructor and the type of project. Studying the type of project according to the site location and analyzing it. This could be achieved by collecting data, start sketching and taking photographs.

### 3.1. RIBA design phases

This research focuses on the early stages of design. In case of architectural design, the process of design is distinct compared to other domains. according to design practice into the definitions by RIBA (Royal Institute of British

3. Brainstorm and Analyze Ideas: In this stage, the student is now able to start understanding how all the data and information that was collected prior can reflect on the design project.

4. Develop Solutions: Take your preliminary ideas and form multiple small-scale design solutions including sketches, drawings, etc.

5. Gather Feedback  
Design ideas and developed drawings are presented to instructors and professionals in order to share their comments and recommendations for further improvements.

6. Improve Work: It is based on the reflection on all the feedbacks taken from instructors' comments and feedback.

Architects), the design process for any project is divided into several stages (Table 1 elaborates the design phases related to architects).

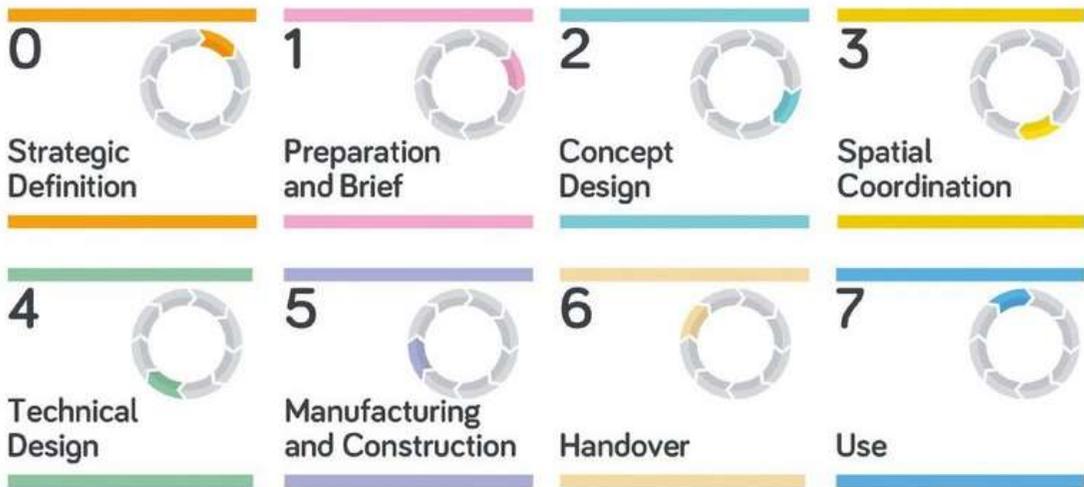


fig. 9 RIBA Plan of work (RIBA, 2020)

**Table 3.** RIBA Plan of work and expected tasks (RIBA, 2020)

	Phases	Phase Type	Expected tasks
Design Process	-Strategic Definition  -Preparation and Brief	Pre- Design Phase	- Site Requirements - Areas and Space Requirements - Space Relations - Site Analysis - Project Requirements - site development planning, - on-site utility studies - zoning and functional analysis, etc.
	-Concept Design  -Spatial coordination  -Technical drawings	Schematic Design and Design Phase	- space layout or space schematics. - conceptual site and building plans. - preliminary sections and elevations - preliminary selection of building systems and materials. - approximate dimensions, areas and volumes, perspective sketches, study models.

### 3.2. Design Studios

Design studios should deliver the right content to students by teaching them how to enhance their creativity in design. In this process, students are trained to develop their design concepts and form generations to meet the right functional use of the project. Afterwards, the students learn how to perform their designs in different ways such as visual graphics, manual rendering or by 3Dimensional modelling animations. Corona Martinez (2003), declared that the design studio is the main key activity for every architect, as the design studio is the place where every student is gathered in order to learn how to become a better designer. Traditionally,

the architectural design process is taught within a studio context. In studios, students are capable to generate ideas and express them, evaluate alternatives as to conclude a decision. Representations are made in a form of sketches, drawings and three- dimensional models. This facilitates testing the hypothesis of the represented designs (Gross et al.,1998). The studio environment enhances the communication and collaboration of students and their interaction together (Student to student- instructor to student) (Anthony, 1991; Boyer et al., 1996).

## 4. Building Information Modeling in the architecture education

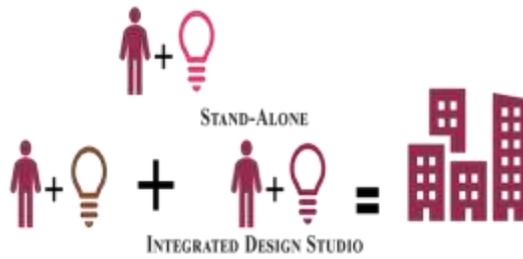
BIM education is the process of learning the knowledge related to BIM workflow, process, tools and technology and protocols. (Succar et al., 2012). BIM education has come out as the result of need to better equip future graduate students with the capabilities demanded by the Architecture, construction and Engineering (AEC) industry (Joannides, et al., 2012). Thus, implanting BIM in courses and modules was a strategy to promote the adoption of BIM in the

architectural education institutions. (Association of Collegiate Schools of Architecture, 2010-11; Barison & Santos, 2010a, 2010b; BIM Industry Working Group, 2011). Bilal Succar, has founded the BIM education working group (EWG) in December 2011 out of 11 members in order to influence the importance of integrating Building information Modelling into the educational process (Succar et. al, 2012).

### 4.1. BIM Stand Alone classes and BIM process Integrated design studio

Teaching BIM within Architectural education sector could be divided into two pillars; Stand-Alone BIM Classes and Integrated Design Studio as referred in fig.9. First, the stand-alone BIM classes method is the way of teaching BIM only as a 3-dimensional modelling software. (Association of Collegiate Schools of Architecture, 2010-11). This method has been firstly implemented in the mid-90s by two USA universities, Georgia Institute of Technology and The Texas A&M University (Barison &

Santos, 2010a, 2010b). On the contrary, the idea of creating an Integrated Design Studio has been introduced in 2006 in Penn-State University and in G- Lab in Milan and other universities (Barison & Santos, 2010a, 2010b; Mandhar & Mandhar, 2013; Onur, 2009).



**fig. 10** Stand-alone vs. Integrated design studio (By Author<sup>a</sup>, 2019)

#### 4.1.1. BIM Integrated Design Studio Case study

An observed and recorded a studio-based design that had a partnership with a professional architect. The case was drawn from a fourth-year group of 18 students. The class was separated into groups at the beginning of the first semester so that they can work together. The studio project was introduced by a client in the Dublin City Council Architectural Department. The student groups were assigned to work within 12 weeks. Only group no 4 was selected by the architect because of their commitment to work with a BIM process. Unit four consisted of six students, five of the students had, the previous

academic year, completed the NQAI Level 7 BSc in AT. The sixth student had received his award the previous year. The first meeting with the architect was on week 2, the architect decided to take one typical building block consisting of eight senior citizens apartments on two levels with a space to the east gable end for a proposed tower block six stories high. Students had 4 meetings with the architect over the 12 weeks duration.



**fig. 10** Students' First collaborative meeting



**fig. 11** Students developing design through sketches

The second observed collaborative design meeting took place in week five, completed drawing were to be submitted on week 7 and the final observed collaborative design meeting was on the week nine. Presentation to the client of group work took place in week 12. This provided an insight into the thinking of the group through interaction, conversations and within the integrated BIM process. The author took notes of the interaction between the students and saw the Revit collaborative application working. It was observed in each case a positive reaction to the collaborative working on the digital model. The group always sat around a large table in the students' studio where each member had a view of each other and were able to contribute verbally to the discussion. On the table were a large selection of hand sketches done in pencil and pen on light transparency paper. In the early discussions the researcher noticed that all the plans and elevations of the concept by the architect were in a hard-line sketch format. One of the groups more advanced in Revit started to address the design project. In the next stage students continued a methodology of designing the concept solution using sketches on light transparency papers. The author noticed that when the architect was explaining an idea in

relation to a portion of the building, he used his hands to form 3D shapes and volumes to give expression the idea and to make it easier to understand and visualize. As the number of sketches increased, problems occurred. Locating sketches became difficult as the group had to shuffle through pieces of paper to manage drawings together. By the end of week four the group was contributing as collaborators in the design process with their increased commitment to and involvement with the project. They were representing the design information to the architect with hard copies drawn from CAD formats. The architect continued investigating design changes using transparency paper overlays and pencil sketching. Although there were areas of the design still not fully resolved the students had a submission deadline for the end of week seven to submit general arrangement drawings for formative assessment on their project and the students decided it was time to develop the BIM model. The building elements were grouped into work-sets with each student taking responsibility for a set. The general arrangement drawings were handed up on time and following formative assessment by the fourth-year studio staff unit four received the highest mark in class for their work.



fig. 12 Students introducing BIM Model to the architect

### 5. Research Methods

The study focused onto applying a survey questionnaire in appendix A to year 1 architecture students of the British University in Egypt to investigate their current acquaintance about integrating BIM process into the architectural design process. The research focuses onto the closed ended questions. The closed ended question is one that gives multiple

choice responses that can be rating questions, a yes or no question, rating scale or even statements that the respondent must choose the relevant answer from his point of view out of the provided answers (Siniscalco & Auriat, 2005). The questionnaire was distributed amongst 62 students.

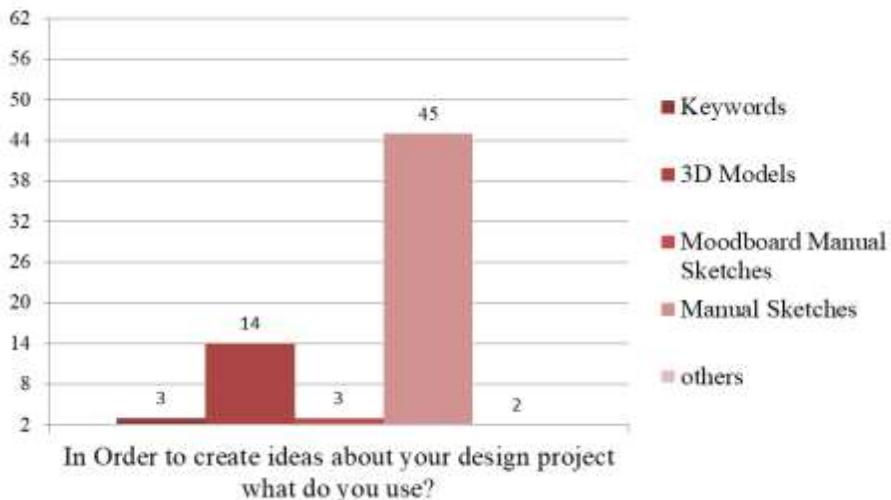


fig. 13 No of students checked (By Author,2020)

No. of students who answered with (Manual sketches) were 45 students out of 62 which represents 73% of the total students. However,

14 students of percentage 23% only who answered with (3D Models).

### Choose the best steps of a design process

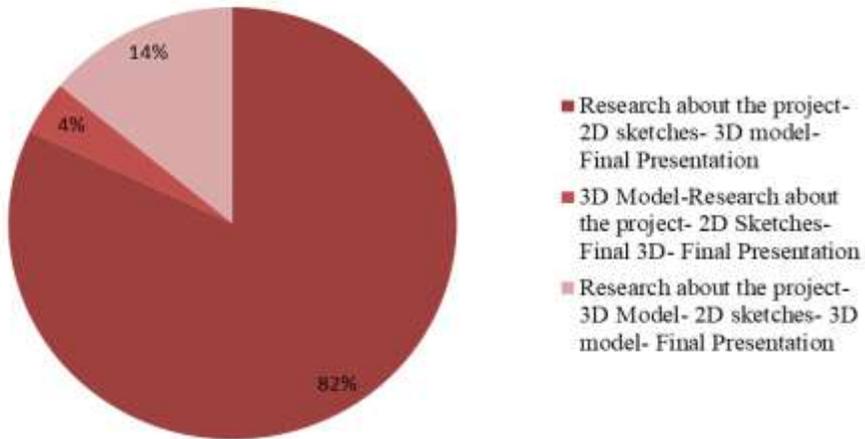


fig. 14 Percentage of students on design process (By Author, 2020)

This indicates that students don't use the 3D modeling at the beginning of their work as they prefer using it in late work.

### Do You Know BIM (Building Information Modeling)?

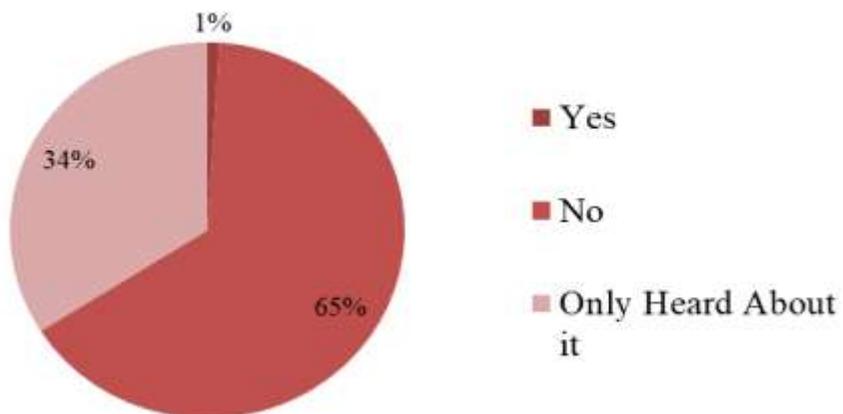


fig. 15 Percentage of students knowing BIM (By Author, 2020)

The main basic question about if the student knows about BIM or not. 40 students out of them which represent 65% answered no, 1

answered yes and the other 21 students of 34% said that they only heard about it.

Do you find creating a model in your project can help you understand more?

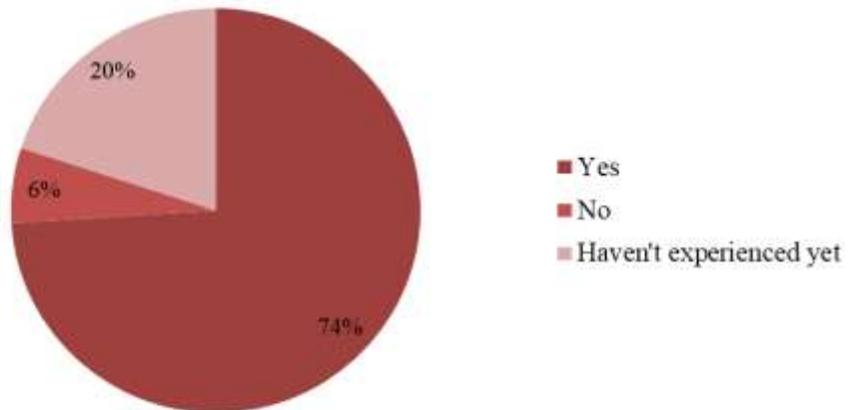


fig. 16 Percentage of students whom find creating a 3D model useful or not (By Author, 2020)

Do You Prefer Working Individually or in a group?

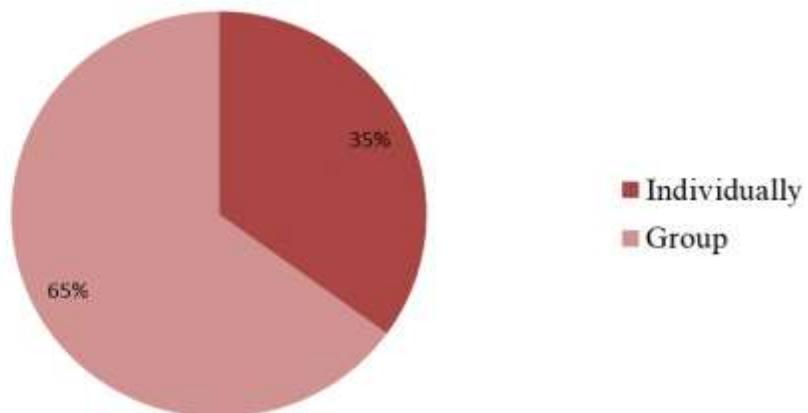


fig. 17 Percentage of students whom prefer working individually or in groups (By author, 2020)

40 Students answered that they prefer to work individually which assures that they do not understand the importance of integrating BIM process and its importance in enhancing

collaboration and communication through visualized models.

## 6. Discussion

This paper is a call for architecture universities to think seriously about making BIM process as an integral part of design studios process. Some universities were able to transform this change

however, others lack its integration. The following tables describe both the traditional design process and the BIM process in design.

Each process phase has its representation tools and types.

**Table 4.** Traditional Design process (By Author<sup>a</sup>, 2020)

		Representation techniques and tools									
		Sketching	Textual (Keywords, data, etc.)	Graphical illustrations	Tracing Papers	Software			Modeling		
											
Traditional Design Process	1. Design Brief and Gathering Information		•	•							
	2. Site Analysis		•	•							
	3. Functional Analysis and Zoning	•	•	•							
	4. Form Generation	•			•				•		
	5. Concept	•	•		•						
	6. Plans, elevations, sections and layout				•	•		•			
	7. Modeling	•			•					•	•
	8. Final Presentation			•		•	•	•		•	•

**Table 3.** BIM process in design (By Author<sup>a</sup>, 2020)

		Representation techniques and tools									
		Sketching	Textual (Keywords, data, etc.)	Graphical illustrations	Tracing Papers	Software			Modeling		
											
BIM process in the Design phases	1. Design Brief and Gathering Information		•	•					•		
	2. Site Analysis		•	•					•		
	3. Functional Analysis and Zoning	•	•	•					•		
	4. Form Generation	•			•				•		
	5. Concept	•	•		•				•		•
	6. Plans, elevations, sections and layout				•	•			•	•	
	7. Modeling	•			•		•	•		•	•
	8. Final Presentation			•		•	•	•		•	•

**Table 4.** Comparison between both traditional design process and BIM design process (By Author <sup>a</sup>, 2020)

	Traditional Process					BIM Process					
	Textual (Keywords, data, etc.)	Graphical illustrations				Textual (Keywords, data, etc.)	Graphical illustrations	Mass Modeling			
1. Design Brief and Gathering Information	Textual (Keywords, data, etc.)	Graphical illustrations				Textual (Keywords, data, etc.)	Graphical illustrations	Mass Modeling			
2. Site Analysis	Textual (Keywords, data, etc.)	Graphical illustrations				Textual (Keywords, data, etc.)	Graphical illustrations	Mass Modeling			
3. Functional Analysis and Zoning	Sketching	Textual (Keywords, data, etc.)	Graphical illustrations			Sketching	Textual (Keywords, data, etc.)	Graphical illustrations	Mass Modeling		
4. Form Generation	Sketching	Tracing Papers	Mass Modeling			Sketching	Tracing Papers	Mass Modeling			
5. Concept	Sketching	Textual (Keywords, data, etc.)	Tracing Papers			Sketching	Textual (Keywords, data, etc.)	Tracing Papers	Mass Modeling	Graphical Model	
6. Plans, elevations, sections and layout	Tracing Papers	2D CAD	Other Software			Tracing Papers	2D CAD	Mass Modeling	Physical Model		
7. Modeling	Sketching	Tracing Papers	Physical Model	Graphical Model		Sketching	Tracing Papers	Physical Model	Graphical Model		
8. Final Presentation	Graphical illustrations	2D CAD	Other Software	Physical Model	Graphical Model	Graphical illustrations	2D CAD	Revit	Other Software	Physical Model	Graphical Model

The previous questionnaire results prove that there is a need for the integration of Building

information modeling thinking process into the architecture design studios.

### 7. Conclusion and Recommendations

After understanding the definition of BIM and its implementation through the past decades till the time being, it is mandatory to understand its importance of integration and improvement in the Architecture, Engineering and Construction (AEC) industry. Despite the implementation of BIM technology and tools in the architectural education, which has been integrated prior in universities, BIM process is still not introduced to most of design studios. This problem creates a gap between the architectural education and the upcoming advancements in Egypt. Thus, a further action should be taken to fill in this gap. A comparison has been created by the author to relate the traditional design process within the BIM dimensions of design (1D to 3D). This is clearly obvious into the presence of mass modeling within the design phases. Finally, this

comparison took the chance to be implemented in a design 1 module at the British university in Egypt. The module coursework brief as shown in fig. 10,11 has been modified to match BIM's goals. This Module was specifically chosen in order to implement the process of BIM within a design studio to students at their early stages of education. This would create a base about what is Building Information Modelling and its importance of integration. Looking forward to further research about whether this experiment is applicable or not. It is also recommended not only to focus onto the implementation of BIM process in the design studio. BIM Process should also be implemented within the further dimensions (4D, 5D, 6D and 7D) which focuses on the time, cost, facility management and sustainability.

Week No.	Lecture	Tutorial
1	Introduction to Course ;functions of residential units Zoning ,functional analysis ,Design matrix ...etc	1-Analysis of relationships and bubble diagram of a given design plan. 2-Editing of given plan according to bubble diagram. 3-Introduction to: functional analysis, spatial requirements of different function and residential units, presidents' analyses. 4-Introduction to group research.
2	Land building law, Environmental conditions and sustainability	1-Editing of the Given plan according to land conditions & Environmental consideration.  2- Introduction to Group research environmental conditions and sustainability.
3	Lecture about Design philosophies and concepts Examples of small residential unit concepts. 1-introduction to individual project.  2- Introduction to Conceptual model 1/100 cork. 3-introduction to Land analysis, zoning and bubble diagram for the given design project on A3 sheets.	Presentation of group research
4	Follow up	1-First zoning and plan draft. 2-Follow up on plans 1/100 3-Follow up on conceptual model 1/100.
5	1-Section Drawings and structural	1-follow up on conceptual section drawings 2-follow up on conceptual plans and study model.
	elements 2-Sectional and plan models	3-Introduction to Detailed sections and model structure plan.
6	Concepts Development and facades' design.	1-follow up on detailed sections and model structure Plan.  2-Introduction to elevation drawing with appropriate presentation. (Shade and shadow, line weight and scale elements).
7	Lecture on lay out drawing & presentation of final mass model	1- Follow up on elevations sections and plans 2- Introduction to final detailed mass model with elevations 3- Introduction to layout drawing.
8	Presentation of design projects.	Submission of semifinal sketch plans, sections, elevations and layout on A3 sheets for portfolio.
9	<b>follow up on pencil drawing , review of presentation process and feed back</b>	
10	Pre final submission portfolio and 3 d models  Pencil drawings complete	
11	Final Submission of project including drawing A3 boards and mass model + introduction of one Week project & one week publication via e-learning.	
12	Submission of one week project	
13	Revision	

fig. 13 Design 1 Module coursework brief at the BUE (The British University,2015)

Week	Lecture	Tutorial	BIM PROCESS
1	Introduction to Course , design brief , design requirements, Matrix ...etc. Bim as a process and its impact on design according to Context	1- Introduction to: functional analysis, spatial requirements of different function and residential units, presidents' analyses. 2- Class exercise on analysis of relationships and bubble diagram of a given design plan. 3- Editing of given plan according to bubble diagram. Using the given information in editing the given data.  Introduction to group research.	UNDERSTANDING
2	Lecture on site analysis and context model. Site Visit & exercise on site analysis		COMMUNICATION+ UNDERSTANDING
3	Delivery of context model Presentation of group research submission (20 %)		COLLABORATION
4	Lecture (Design philosophies & concepts examples of small residential unit concepts. 1-Introduction to individual project. 2- Introduction to Conceptual model 1/100 according to context	<b>Workshop within tutorial</b> 1- Exercise on generating 3 d model according to contextual, functional requirements & concept. 2- Draft plans of the generated model.  Homework: plans 1/100 + Concept model	VISUALIZATION + INTEGRATION
5	Introduction to material and its impact on building typology. 2 <sup>nd</sup> BIM process  1-Section Drawings and structural elements 2-Sectional and plan models	<b>Pin up:</b> 1- Conceptual plans 2- Conceptual plans and study model. 3-Lay out and individual land analysis & concept studies  Homework: sections and model plans with structure (5%) of portfolio.	COMMUNICATION + VISUALIZATION
6	Concepts Development and facades' Design.	1-follow up on detailed sections and model structure Plan.  2-Introduction to elevation drawing with appropriate presentation. (Shade and shadow, line weight and scale elements).	UNDERSTANDING + VISUALIZATION
7	Lecture (lay out drawing & presentation of final mass model)	<b>Pin up :</b> 1- elevations sections and plans 2- sectional model 3- layout 4-model plan. (the plans & section details will be submitted and revised in the course of building construction).  (5%) of portfolio	INTEGRATION + COLLABORATION WITH STRUCTURE MODULE + VISUALIZATION
8	Presentation of design projects. Introduction to sketch-up	Follow up on complete project drawings Submission of semifinal sketch plans, sections, elevations and layout on A3 sheets for portfolio.	
9	Pre final Pin Up complete pencil drawings 5 % portfolio		
10	Lecture about presentation styles and format	Physical Model submission & portfolio submission 10 % +5 %	
11	Official holiday		
12	Final Submission of project including drawing A3 boards and mass model + introduction of one Week project & one week publication via e-learning 20%		
13	Submission of one day project 30 %		

fig. 14 Design I Module edited coursework brief at the BUE within the BIM context (By Authors <sup>a,b</sup>, 2020)

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# اطر لتعليم الأجيال المعمارية القادمة من خلال دمج عملية نمذجة معلومات البناء الثلاثية الأبعاد BIM في استوديوهات التصميم المصرية

## المخلص:

أصبحت نمذجة معلومات البناء الثلاثية الأبعاد (BIM) منتشرة في جميع أنحاء العالم وقد بدأ إنتشارها في مصر ، بدءاً من منتصف عام 2000 ، حيث تم تقديم BIM كتقنية جديدة تسهل فرص التعاون ومشاركة المعلومات من خلال النمذجة الذكية في مجال الهندسة المعمارية والهندسة والبناء . و بالنظر في منهجية تعليم التصميم المعماري في الجامعات المصرية ، وجد ان طلاب المرحلة الجامعية يفتقرون إلى فهم ومعرفة أسس نمذجة المعلومات الذكية كمنهجية تصميمية وممارسته كعملية متكاملة طوال سنواتهم الأكاديمية حتى التخرج حيث يركز معظم الطلاب علي استخدام برامج النمذجة كأدوات إظهار معماري وليست منهجية تصميمية متكاملة تشمل جميع مراحل التصميم ، حيث تتميز بدمج وتبادل المعلومات التي تؤدي إلي تطوير التصميم خلال مراحل التصميم المختلفة . وبالتالي ، يهدف هذا البحث لطرح بعض المبادئ التوجيهية لدمج BIM كمنهجية تفكير خلال مراحل تصميم المشروع و من ثم تطبيق تلك المنهجية في استوديوهات التصميم للجيل القادم من طلاب الهندسة المعمارية. حيث يفترض البحث أن تبني وتدمج تلك الإرشادات الخاصة بمنهجية التفكير الخاصة بنمذجة المعلومات BIM بطور من أداء الطلاب و المشروعات المقدمه بالإضافة ألي مهاراتهم التصميمية. و ينتج تخرج جيل مؤهل لتلبية المتطلبات المهنية المطلوبة بعد التخرج. ويركز البحث على التعرف على منهجية نمذجة معلومات البناء BIM في مراجعة متعمقة للأدبيات بالإضافة إلى مناقشة عملية تصميم العمارة التقليدية في استوديوهات التصميم. كما ستتناول دراسات لبعض التجارب الدولية في الجامعات عند دمج BIM في استوديوهات التصميم. في الختام ، سيتم إستنتاج مصفوفة مقارنة بين كل من عملية التصميم التقليدية وعملية التصميم إستخدام منهجية BIM في استوديوهات التصميم المعمارية. ويخلص البحث إلي مجموعه من التوصيات لدمج منهجية نمذجة معلومات البناء الثلاثية الأبعاد داخل الفصل الدراسي بهدف توفير الإحتياجات في سوق العمل لممارسي مهنة التشييد والبناء.