Towards an advanced scientific methodology for using artificial intelligence technology in architectural design studios (An applied study with the participation of architecture students)

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ABSTRACT:

The research paper deals with the problem of architects in the absence of a clear understanding of the need to move towards the use of digital technologies and artificial intelligence and rely on advanced programs and innovative solutions that can be provided in general and in architectural design studios in particular. In the paper, the shortcomings of the current studies are discussed in a clear way to address an important aspect of architectural thought, which is the change in the design methods of the design studios in the faculties of architecture to accommodate the technology of artificial intelligence and find a methodology to apply it in the design studios at the level of the studio space and the content provided for the architectural student.

Keywords:

Digital Architecture - Artificial Intelligence - Augmented Reality -Virtual Reality - Architectural Education

الملخص:

تتناول الورقة البحثية مشكلة المهندسين المعماريين في ظل عدم وجود فهم واضح لضرورة التحرك نحو استخدام التقنيات الرقمية والذكاء الاصطناعي والاعتماد على البرامج المتقدمة والحلول المبتكرة التي يمكن أن تقدمها بشكل عام وفي استوديوهات التصميم المعماري بشكل خاص. وفي الورقة تتم مناقشة أوجه القصور في الدراسات الحالية بطريقة واضحة لمعالجة جانب مهم من الفكر المعماري وهو التغيير في أساليب التصميم لاستوديوهات التصميم في كليات العمارة لتستوعب تكنولوجيا الذكاء الاصطناعي وايجاد منهجية لتطبيقه في استوديوهات التصميم على مستوي شكل فراغ الاستديو وعلي المحتوي المقدم للطالب المعماري.

الكلمات المفتاحية:

العمارة الرقمية، الذكاء الاصطناعي، الواقع المعزز

intorduction:

Technologies related to artificial intelligence have become one of the most important outputs of the digital revolution and its technological implications, which have a dynamic and effective impact on architectural design in the academic context. The artificial shape of spaces in design studios and the need for flexible spaces to accommodate this technology to enable students to teach and practice it.

The Main Objective of the Research:

Finding a design methodology aimed at using the means and techniques that help in enhancing the abilities and skills of the student architecture, starting from computer programs, and up to virtual and augmented environments. Finally, using artificial intelligence and providing a mechanism for applying these means in design studios through the content provided for the student or the form of the future designs' studio.

1-1 Architectural education and the digital revolution:[1]

The digital revolution has created programs for architectural design, and it is easy to deal with this program directly and provide simulation programs that enable them to represent reality and choose the correctness and accuracy of their perception of such reality, and artificial intelligence can be used to analyze data, design sustainable buildings, improve building performance, and improve the overall efficiency of the building in the future.
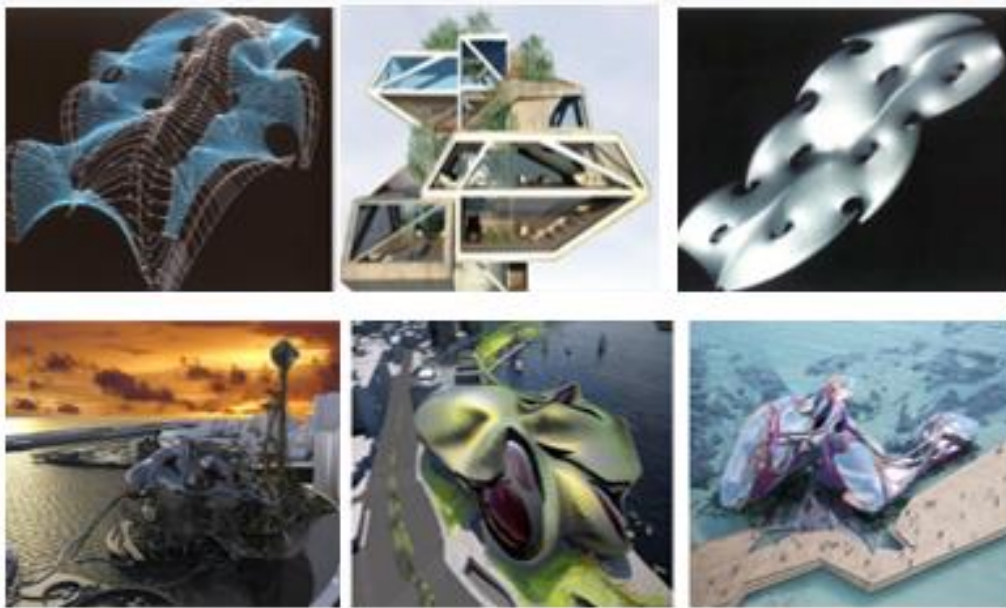

Fig (1) illustrates some of the shapes used digital revolution source Kolarevic, B. (Ed.). (2004). Architecture in the digital age: Design and manufacturing. Taylor & Francis.

1-2 Virtual Reality: [2]

Virtual reality means the creation of similar and real environments or may be completely imaginary by computer, and these environments can be physically integrated into it and aim to create and design highly efficient human environments and also aim to control the lifestyle to form or reconfigure it to satisfy the person's psychological and sensory desires.

Figure (2) showing How Virtual Reality Is Changing the Architecture Industry
Source https://www.adorama.com/alc/virtual-reality-architecture/

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1-2-1 The impact of Virtual Reality Technique on the architectural design:

1-2-1-1 The impact on the Design: [3]

The provision of virtual reality technologies will allow the formation of the stages of architectural design, not only because of its promising ability as a tool for visual communication, but also because it provides a service of a high degree of importance and effectiveness that can be understood as an opportunity for a "trial run" for the architectural designer to test his designs, and thus the architect gets through that technology, better results than when design testing and review stages are done through two-dimensional drawings .

Figure (3) showing: How impact of Virtual Reality Technique on the architectural design
Source https://www.chapmantaylor.com/insights/what-are-the-benefits-to-architects

1-2-1-2-1-2 The impact on the Architect: [4]

The designer used to design and show his design ideas of a two-dimensional environment even if he used the three-dimensional programs, but the technique of virtual reality will allow him to use a three / quad dimensional environment as the architect can roam through this environment into the project.

1-2-1-2-1 The Most important application - cave room: [5]

This technology aims to make the user fully immersed in the virtual environment. The cave consists of a system consisting of a room in the shape of a cube 3 * 3 * 3 meters, the sides of this cube are side projection screens, and the floor of the cube acts as a bottom projection screen, the participant in such a situation is located inside the cube and the movement of the participant in this case represents interaction with virtual reality (VR) tracked by electromagnetic sensors.
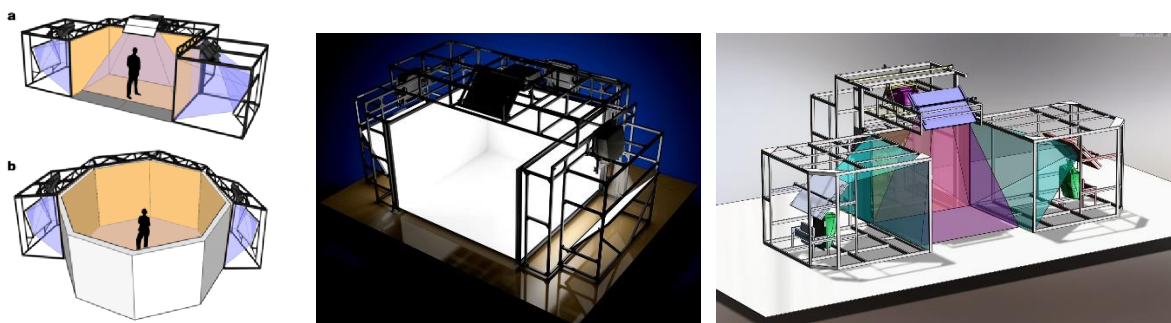

Figure (4) cave room detail source
https://vrtifacts.com/cave%C2%AE-a-virtual-reality

1-3 Augmented reality (AR): [6]

Augmented reality is a new type of technology Electronic user interface (Interface), where Knowledge is conveyed to users in a visual experience and the augmented reality mechanism works using Video camera to capture scenes of the environment Surrounding, augmented reality software systems are used Rapid image processing techniques for marker identification one or more placed in the scene.

Figure (5) Augmented Reality vs. Virtual Reality vs. Mixed Reality source
https://arvrtech.eu/why-do-you-need-an-augmented-reality-app-for-your-business/

1-3-1 The impact of Augmented Reality Technique on the architectural design:
1-3-1-1 Mobile Application AR. VR: [7]

The availability of smartphones with built-in gyroscopes means that they are a popular method of displaying AR. VR, either as a standalone device or combined with Mobile Head-Mounted Displays (HMDs).
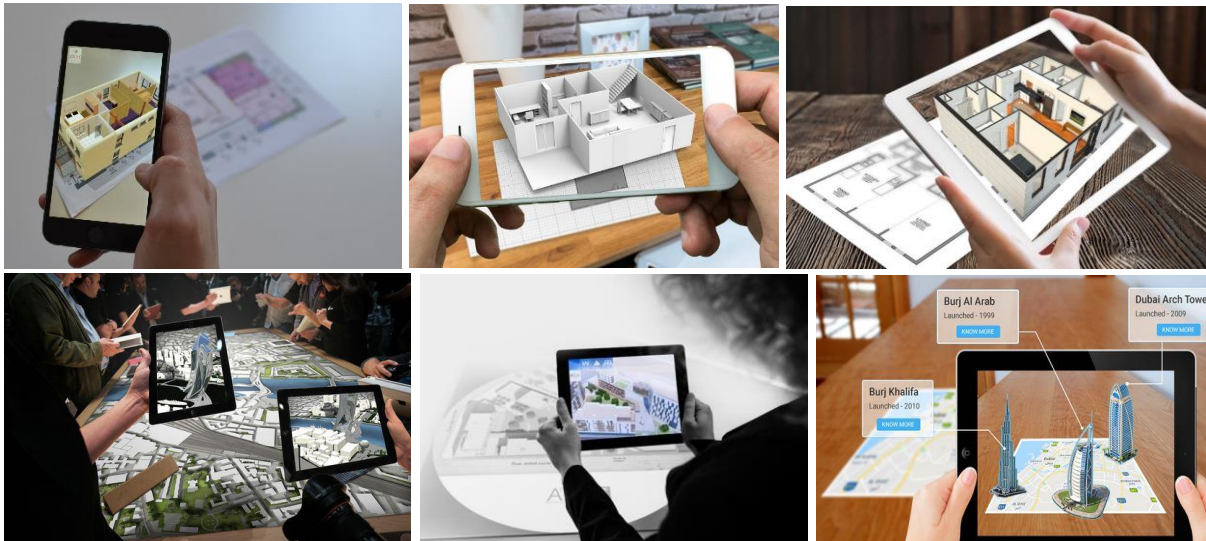

Figure (6) Augmented reality application source
https://www.architectmagazine.com/technology/products/three-augmented-and-virtual-reality-apps-for-design-and-construction_o

2-Artificial intelligence in architecture: [8]

The term artificial intelligence in architecture is defined as the ability of digital machines and computers through systems and information to do human work such as mental processes, thinking and learning. By entering a set of data onto it, analyzing it, and processing it, the concept of artificial intelligence entered architecture of early 2015. A group of researchers and developers specializing in artificial intelligence. (Artificial intelligence) worked on developing computer technologies that allowed computers to automatically recognize image elements by adding Exact description of each photo.
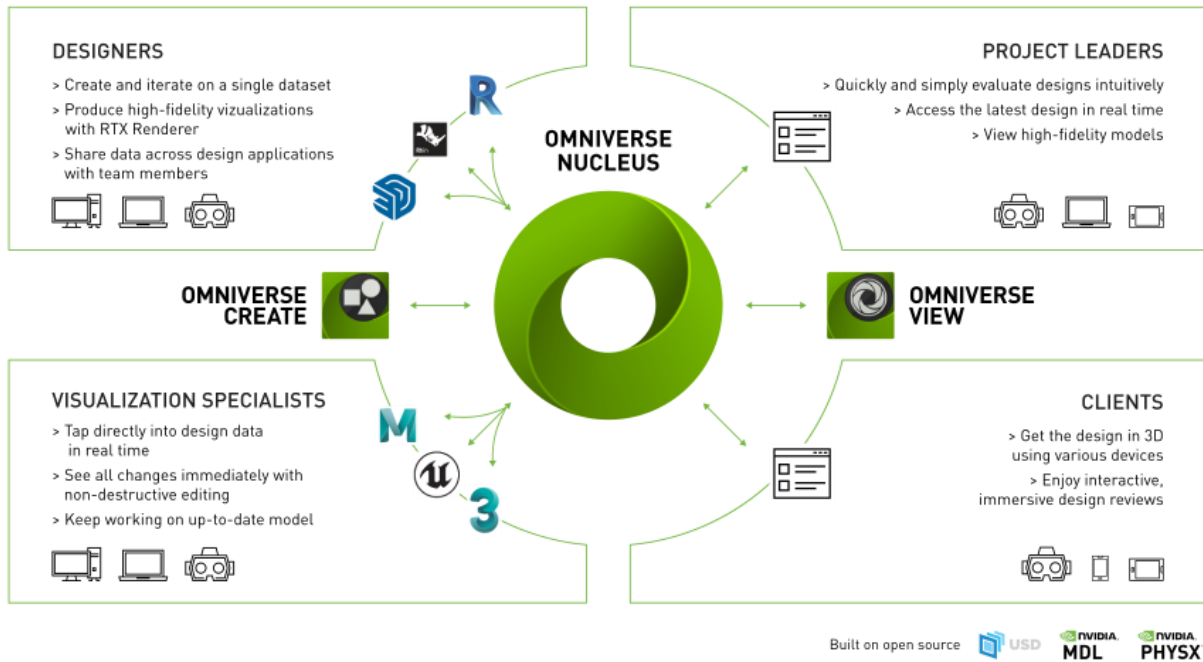
Figure (7) showing the impact of artificial intelligence on architectural education
Source https://www.exxactcorp.com/blog/Deep-Learning/ai-in-architecture

2-1 Applications of Artificial Intelligence in Architecture: [9]

Applications of artificial intelligence in architecture. The most famous of which are the **Mid journey** site and the **DALL-E-MINI** site and the **AI RENDER** site, where these sites are based on entering an accurate description of everything that engineers or designers imagine to obtain accurate designs, so that they provide many suggestions for one description.

Figure (8) showing Applications of Artificial Intelligence in Architecture
https://www.lovethatdesign.com/article/creator-vs-creation-what-will-the-future-of-ai-in-design-look-like/

2-1-1 Example: How to work Mid journey Application:

1. Go to the Discord website and download the program to your phone or computer.

2. Register a discord account and keep the data.

3. Go to the Midjourney website and click on Join the Beta.

4. A discord page will open and you will be asked to click on certain photos.

5. A page will appear as the following page, click on the boat mark or Midjourney,

then go into one of the rooms like the one that starts with newbies.

7. A bar will appear at the bottom, in which write /imagine: Prompt and write the shape of the design that you imagine and that you require the AI to design for you.
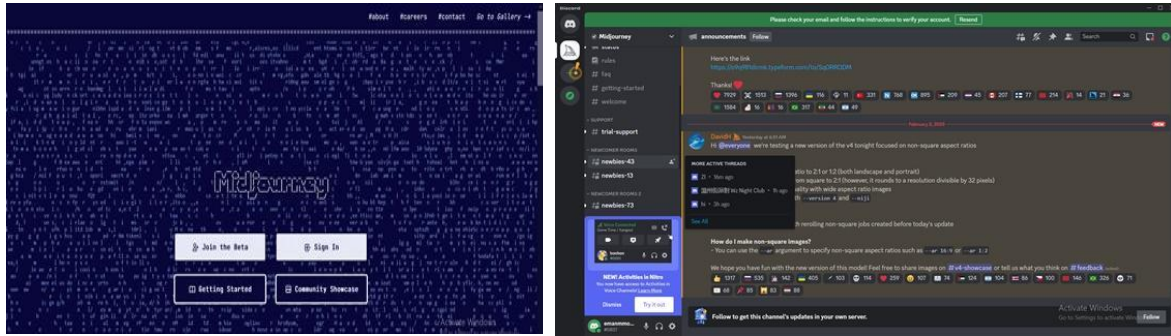
Figure (9) showing how to work Midjourney
https://beytk.net/artificial-intelligence-in-decoration/

2-1-1-1 Example work with Midjourney:

Figure (10) showing example Midjourney work
https://www.lovethatdesign.com/article/creator-vs-creation-what-will-the-future-of-ai-in-design-look-like/

2-1-2 Example work with AI RE RENDER:

Figure (10) showing example re render work (Osama Talat architect)
https://www.lovethatdesign.com/article/creator-vs-creation-what-will-the-future-of-ai-in-design-look-like/

2-3 The importance of using AI in Architecture:

The emergence of technologies and artificial intelligence in the field of architecture has led to many benefits, and the importance of using AI in architecture lies in its endeavor to improve the reality of smart architecture by obtaining fast and accurate analysis and modeling data. Preparing a set of proposals and modifying them easily, in addition to enabling the client to visualize the project by presenting possible scenarios and possibilities in different ways and with the smallest details. It also assists the designer in the stage of preparing the architectural design idea (architectural concept) in order to see the architectural space, to test the design capabilities and ideas, their suitability, and to choose the best among them. In addition to the importance of using AI in architecture of facilitating and accelerating the planning, design and implementation processes, with the highest quality and the least time and effort.
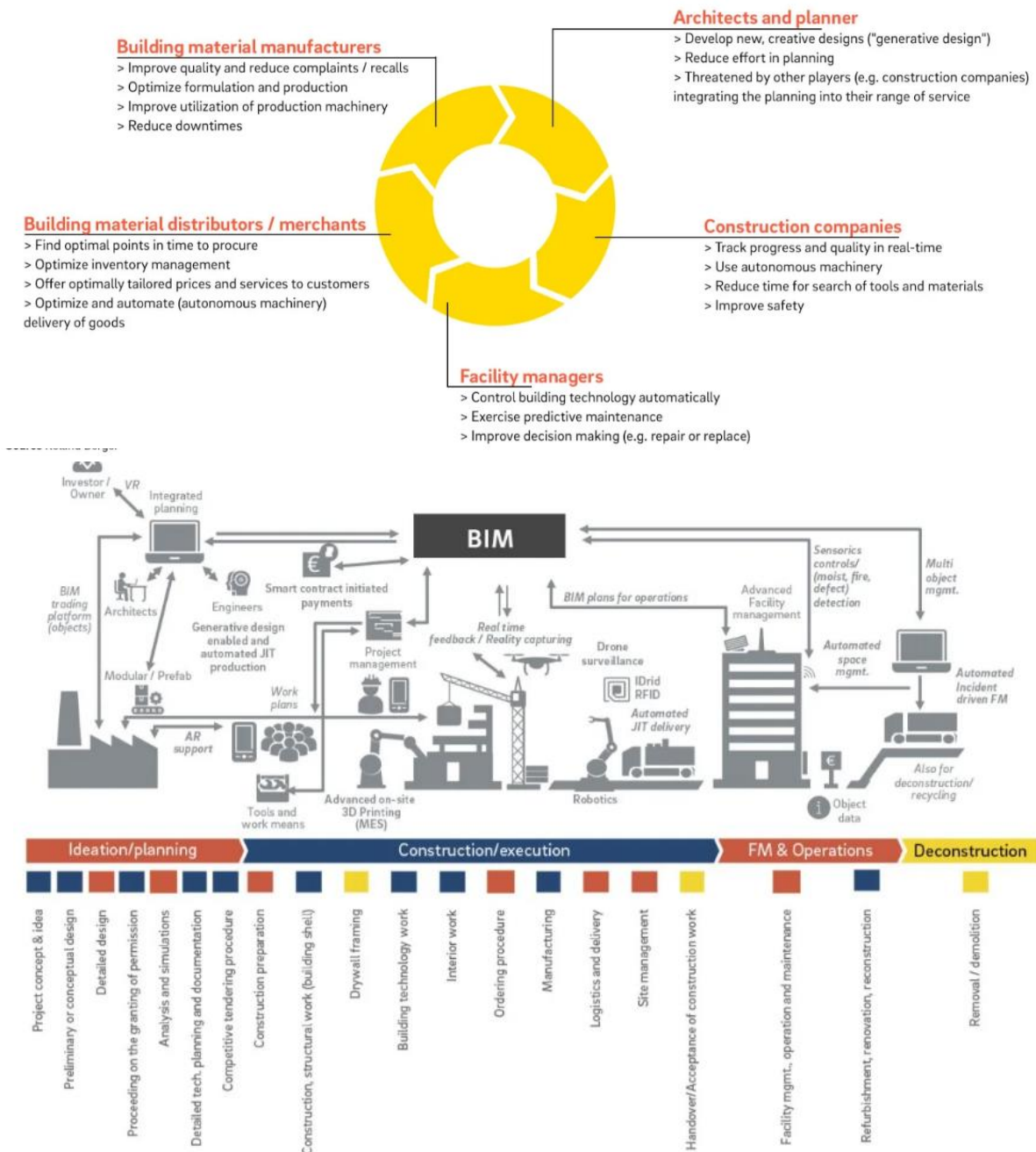
Figure (11) showing the importance of using AI in architecture
https://www.rolandberger.com/en/Insights/Publications/Artificial-intelligence-in-the-construction-industry.html#!#&gid=1&pid=2

3-Design Studio: [10]

The design studio plays an important role in the lives of architectural students and influences creativity. The development of the student's ability to transform theoretical knowledge into a project is one of the most important problems of education.

3-1 Types of Design Studio:
3-1-1 Non-Integrative Design Studio:

In which the design is based on computer-defined programs such as 3D Max, AutoCAD, through which a virtual reality is created on the computer screen.

Figure (12) showing Non-Integrative Design Studio source
https://www.archdaily.com/979182/new-european-architecture-platform-lina-supporting-emerging-professionals-launches-in-junearchitecture-platform

3-1-2 Integrative Design Studio:

Reliance is made on virtual reality technology that creates an environment similar to the real environment through the use of a computer, and this leads to integration and sensory coexistence with it. This technology is based on creating an overlap between computerized information and human senses, with the aim of creating highly efficient designs.
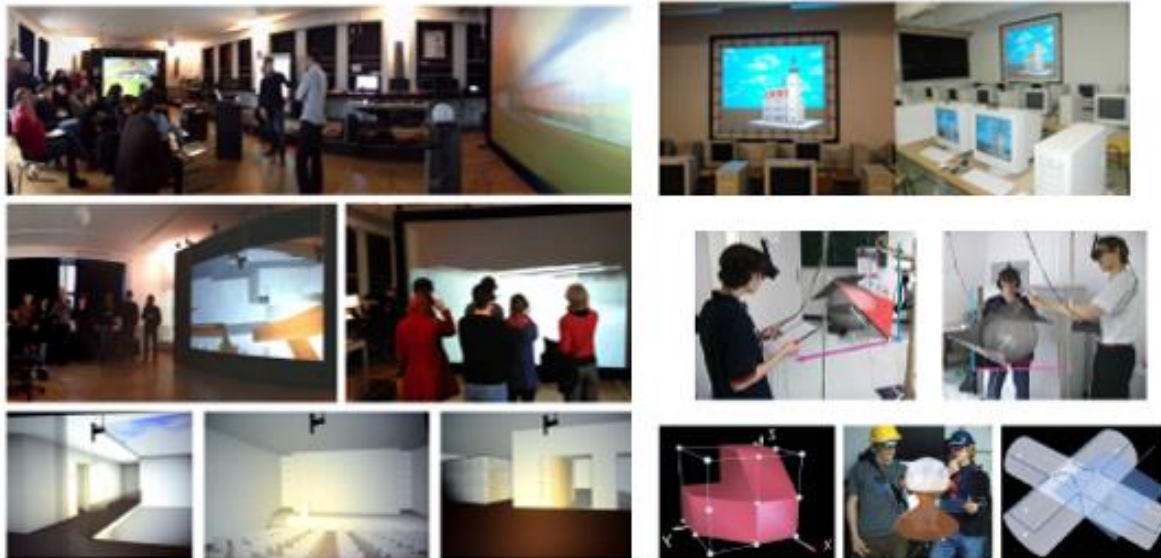

Figure (13) showing Integrative Design Studio source
Images Publishing Group. (2001). Cyberspace: The world of digital architecture. Images Publishing.

4- Methodology for Using Artificial Intelligence Technology in Architectural Design Studios
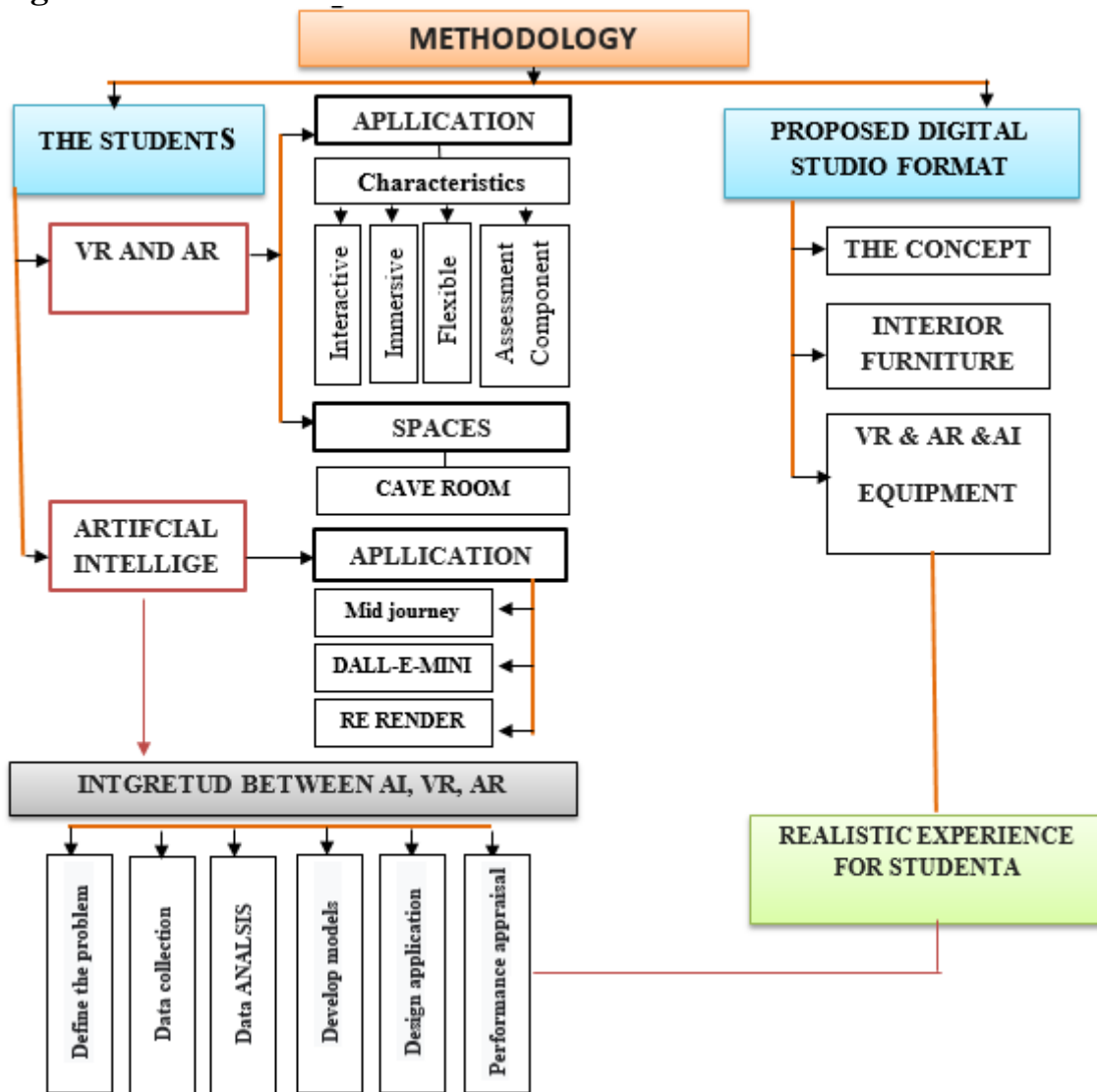

Fig. (14) Methodology for Using Artificial Intelligence Technology in Architectural Design Studios
source: The researcher

4-1 EXPERIMENTAL METHODOLOGY:

The methodology is based on two main axes:

1- The alternative is based on applying the idea of digital architecture to the Egyptian environment and creating a design model for design studios that can be applied in existing universities.

2- Practical participation of students using artificial intelligence programs, while providing educational content that helps them apply ideas.

4-2 Case Study in Egypt Modern Academy for Engineering:
4-2-1 Engineering analysis of the void:

Drawing galleries: The academy contains 15 architectural drawing rooms belonging to the Department of Architecture only, all of which are located in the annex building.
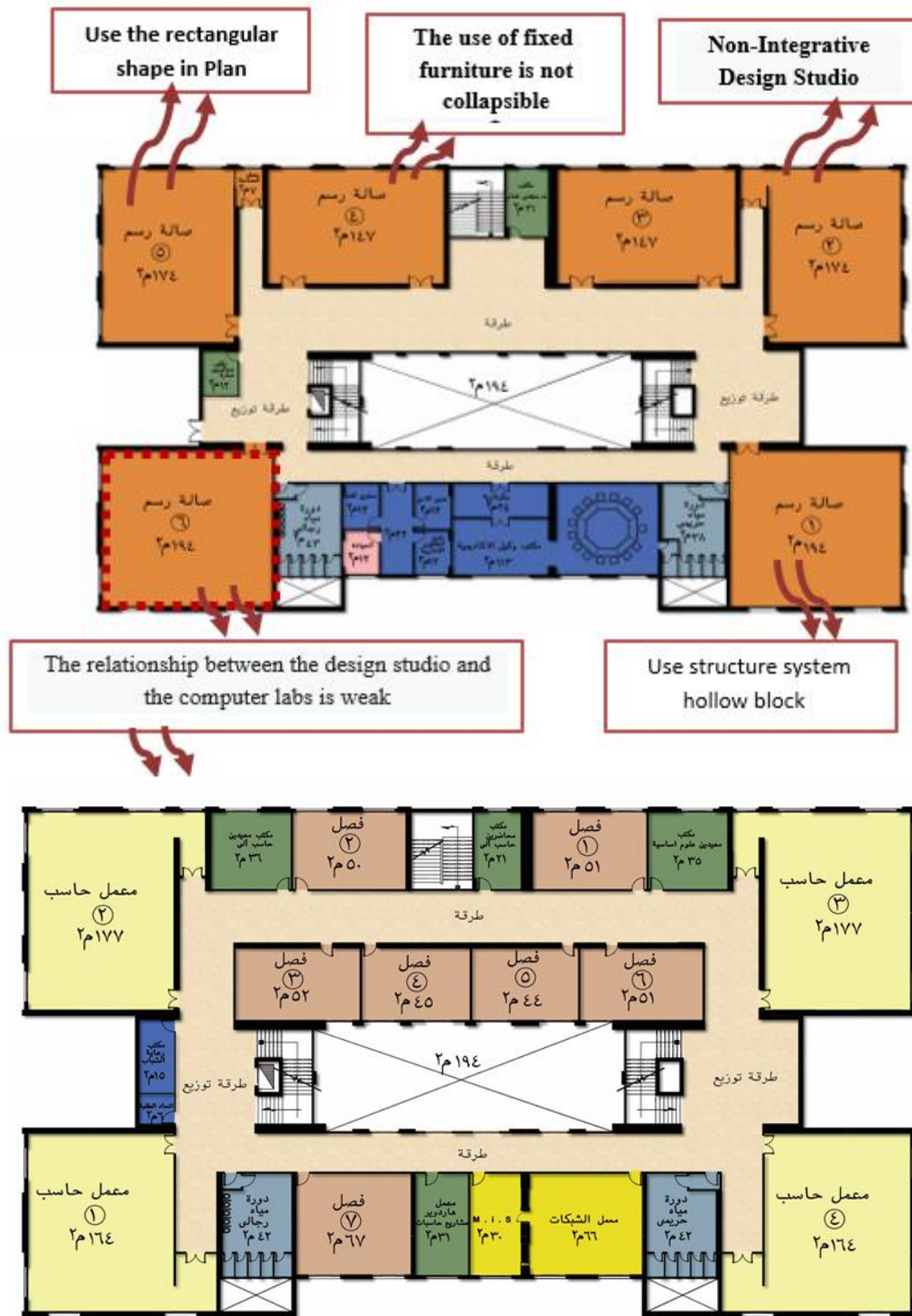
Fig. (15) Drawing hall in modern academy
source: researcher

Design Idea: The idea of the proposed alternative is based on using a space that uses the latest technological methods and uses a comprehensive space system that allows the space to be re-divided into multi-functional spaces and in which the latest technological means used in the education environment are used and allows the application of artificial intelligence technology.
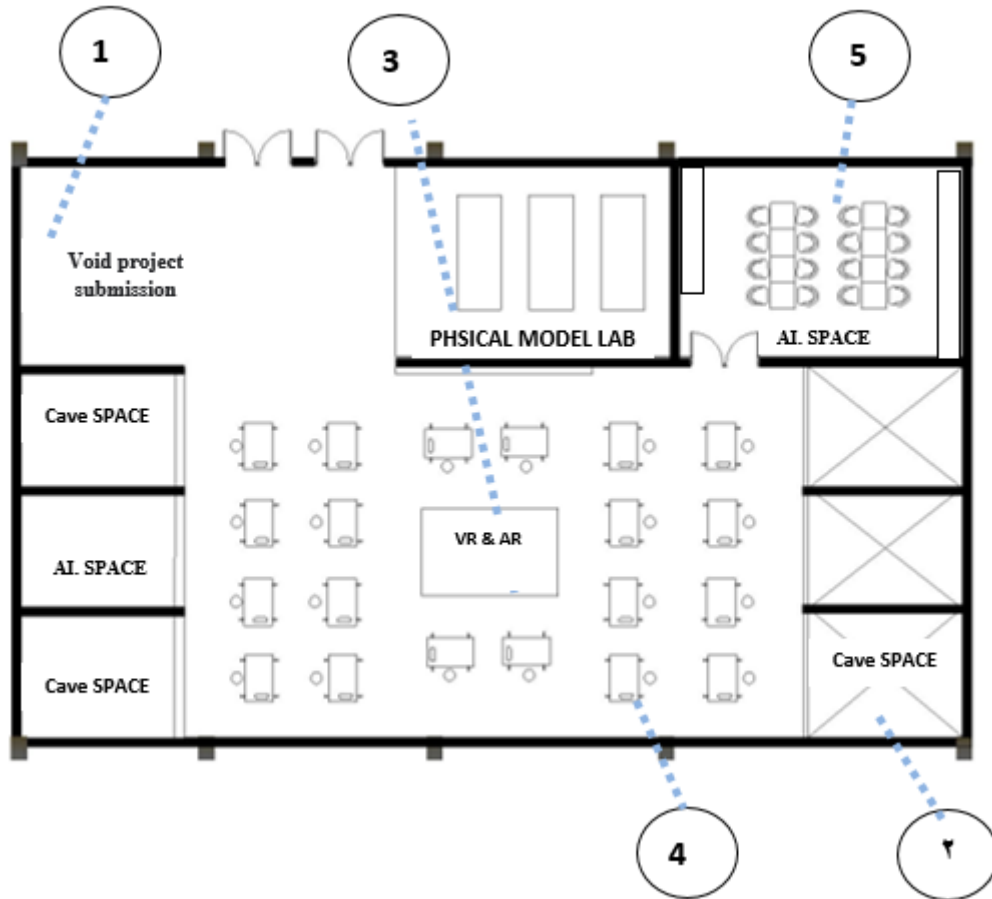
Fig. (16) Design Idea
source: researcher

4-3 Practical participation of students using artificial intelligence programs:

1- The experience of the student Amir Dawood:

Artificial intelligence programs were used in the design phase and the final presentation of the project.

Fig. (17) The experience of the student Amir Dawood
source: The researcher

2-The experience of the student ABRAM:

Artificial intelligence programs were used in the design phase and the final presentation of the project.

Fig. (18) The experience of the student ABRAM
source: researcher

5 - Conclusion & Result:

The architect should not be separated from keeping abreast of new developments and changes from the times for the use of advanced technology in architectural design, especially digital technology and what it can provide of innovative design solutions, especially technology related to artificial intelligence.

The research paper recommends the necessity of redesigning the design studios to keep pace of these developments, with the necessity of evolving the educational content to encourage

students to use this technology in the design stage of the project and what it can offer of many design alternatives, finding non-traditional forms, and access to integrative design studios.

The main findings of the research paper can be summarized as follows:
1- The focus should be on the architect and their rehabilitation to keep up with technological advancements, through the educational content provided to them.
2- The importance of artificial intelligence and its use in the architectural education environment in general, and in the design stage in particular, as an assisting tool in finding non-traditional and innovative forms that increase creativity for the architect.
3- Highlighting the importance of interactive architectural applications, such as virtual and augmented reality, and their role in helping architecture students simulate and present their projects in an innovative way, which helps convey their ideas.
4- Emphasizing the importance of redesigning traditional design studios in architecture schools to make them integrative and keep up with advanced technology, enabling students to use all the tools that enhance their creativity.

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