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# PLANNING A VIRTUAL LEARNING ENVIRONMENT TO DEVELOP FASHION DESIGN SKILLS USING ARTIFICIAL INTELLIGENCE

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## ABSTRACT

*This study aims to design and plan a virtual learning environment based on generative artificial intelligence applications to develop fashion design skills among university students and to verify its effectiveness. The study followed an experimental approach using a single-group design with pre- and post-measurements. The study sample consisted of (30) students. The study tools represented in: virtual learning environment (specially designed for this research), a cognitive achievement test, a practical skills test, and an observation card. The results showed statistically significant differences at the (0.01) level between the students' mean scores in the pre- and post-applications for both the cognitive and skill-based tests, in favor of the post-application; which confirms the effectiveness of the proposed virtual environment in developing knowledge and skills related to fashion design using AI (formulating textual commands, generating designs, editing outputs, and integrating hand-drawn sketches). The study recommended the necessity of integrating AI tools into fashion design curricula, establishing specialized virtual learning environments, and training faculty members on their use, along with establishing a code of ethics for the responsible use of these technologies.*

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**KEYWORDS:** Virtual Learning Environment, Fashion Design, Artificial Intelligence, Design Skills.

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## 1. INTRODUCTION

Our world is witnessing today a massive scientific and technological revolution in the field of artificial intelligence, as whose applications have brought about a qualitative leap in various fields, especially in education. The goal of education is no longer merely the transfer of information, but rather the focus has shifted to developing creative thinking and problem-solving skills, and relying on self-directed learning in light of rapid technological changes (Khaled Abd El-Fattah, 2021 AD, p. 55). Artificial intelligence is considered one of the most prominent of these technologies that contribute to reshaping educational environments and providing customized interactive learning experiences that suit the needs of each learner (Luckin et al., 2016, p. 23).

In the field of fashion design in particular, generative AI tools such as Midjourney, DALL-E, and Adobe Firefly have revolutionized the way designs are created; as they allow the designer to generate unlimited creative ideas in record time, transform simple sketches into realistic designs, and virtually experiment with fabrics and colors (Giri et al., 2023, p. 5). Furthermore, these tools have contributed to the automation of many routine tasks, allowing the designer to focus on the creative and expressive aspects of their work (Särmäkari & Vänskä, 2022, p. 112).

In light of this rapid development, it has become necessary to reconsider traditional fashion design learning environments and transition them to interactive virtual spaces that integrate the capabilities of virtual reality and artificial intelligence. Virtual Learning Environments (VLEs) offer spatial and temporal flexibility, allowing learners access to rich and diverse learning resources and interacting with instructors and peers in both synchronous and asynchronous ways (Clinch, 2005).

Virtual learning environments (VLEs) represent a dynamic electronic community that includes learner, teacher, and learning resources, enabling interaction through the internet and its various applications (Rao, 2004, p. 66; Khamis, 2018, p. 45). They are also known as interactive digital environments that rely on web technologies and provide diverse tools for synchronous and asynchronous communication, contributing to the creation of rich learning experiences that transcend the boundaries of traditional classrooms (Al-Dulaimi, 2018, p. 22; Azmi et al., 2014, p. 440). Various studies have addressed virtual education, such as the study by Chou (2005), which demonstrated the superiority of virtual learning environments in achieving social and cognitive interaction compared to traditional

education, and the study by Amal Nasr El-Din (2008 AD), which confirmed the effectiveness of education through virtual environments and its positive impact on students' attitudes toward learning. Furthermore, the study by (Al-Mansi, 2018 AD) also found that designing a virtual environment based on cloud computing applications is effective in developing technological skills and electronic communication. The study by (Al-Sulaiman, 2020 AD) showed a positive effect of the learner-centered cooperative teaching method in virtual classrooms on improving learning outcomes in favor experimental group. Previous studies have confirmed the effectiveness of these environments in increasing interaction and developing cooperative relationships between teachers and learners.

Studies addressing the use of artificial intelligence (AI) in fashion design have varied, as a study by Ait Yassine et al. (2025) provided a comprehensive systematic review of 200 studies conducted between 2017 and 2025, this study focusing on generative design approaches and virtual simulations. This review confirmed the effectiveness of diffusion models in generating innovative designs. Furthermore, a study by Tocchetti et al. (2025) examined human-AI collaboration in the fashion design process, concluding that these tools are effective in supporting designers' work while also identifying their limitations. A study by Hrešč & Broad (2025) from the University of the Arts London demonstrated the potential of employing AI in participatory design using a "small-data" approach, ensuring customized outputs that reflect the designer's identity. In an applied study, Lee et al. (2025) developed the "CoCoStyle" tool to reflect the subjectivity of style and support decision-making among fashion designers. It proved effective in reducing design time while maintaining creative diversity. In addition to the study by Nagla'a Ta'ima et al., (2025), which aimed to clarify the impact of artificial intelligence on the clothing and fashion industry, it concluded that AI-supported fashion design platforms work to unify the various steps of the designer's process, starting from the product idea, and help designers create new collections that include automated design suggestions.

Despite the diversity of these studies, most have focused on technical aspects and algorithms, while studies addressing the use of artificial intelligence (AI) in virtual learning environments for developing fashion design skills remain scarce.

Given the gap between the rapid development of AI applications and their limited integration into the educational curricula, and as a result of the

increasing pressure on higher education institutions to graduate designers with digital-age skills, it has become essential to plan advanced AI-based virtual learning environments. Therefore, this research aims to design a virtual learning environment for developing fashion design skills using AI and to verify its effectiveness in equipping students with the knowledge and skills necessary to meet the demands of the contemporary job market.

### **1.1. Research problem:**

The research problem is identified by the existence of a gap between the rapid development of artificial intelligence applications in the field of fashion design and the traditional curricula that fail to keep pace with these advancements, resulting in graduates who are not adequately prepared for the digital job market. The research problem can be formulated in the following questions:

1. What are the actual needs (educational, technical, and material) for building an AI-based virtual learning environment to develop fashion design skills in higher education institutions?
2. What is the possibility of planning a virtual learning environment that based on AI applications to develop fashion design skills (designs innovation, fabric selection, and model coloring)?
3. What are the principles and standards for employing generative AI tools and AI-enabled design software in virtual learning environments?
4. How effective is the proposed virtual environment in providing students with the fundamental knowledge related to fashion design using AI (the concept of AI, types of design tools, and their operational mechanisms)?
5. How effective is the proposed virtual environment in providing students with the performance skills related to fashion design using AI (writing effective text commands, using generative software, editing outputs, and integrating them with traditional design software)?

### **1.2. Research objectives:**

This research aims to:

1. Plan a virtual learning environment based on artificial intelligence applications to develop fashion design skills among undergraduate students.
2. Determine the effectiveness of the proposed

virtual environment in developing the cognitive aspects associated to fashion design using artificial intelligence.

3. Determine the effectiveness of the proposed virtual environment in developing the skills (performance) aspects related to fashion design using artificial intelligence.
4. Study the foundations and standards for employing generative artificial intelligence tools in designing interactive courses.
5. Identify the essential requirements (educational, technical, and human) for building intelligent virtual learning environments in clothing and textile departments.
6. Contribute to bridging the gap between educational outcomes and the requirements of the digital labor market in the field of fashion design.

### **1.3. Research importance:**

The importance of this research lies in the following:

1. It may contribute to developing fashion designer preparation programs by providing them with digital-age skills and boosting their capacity for innovation and creativity.
2. Establishing foundational principles and standards for employing artificial intelligence tools in the educational process, ensuring the achievement of educational objectives.
3. It may provide a comprehensive applied model for planning a smart virtual learning environment that can be generalized to other courses in the field of clothing and textiles.
4. The results of this research may contribute to providing higher education institutions with a list of necessary needs and requirements when initiating AI-based digital transformation projects.
5. It contributes to preparing human resources capable of competing in the local and international labor market, as the fashion sector globally moves towards digitalization and artificial intelligence.

## **2. RESEARCH TERMS**

### **Planning:**

A systematic and continuous process aimed to achieve future goals through appropriate means, based on a set of decisions and procedures according to carefully selected priorities, with the objective of attaining the maximum possible investment of available resources and potentials (Mohammed Abd

Al-Razzaq & Mohammed Yunus, 2003 AD, p. 88).

#### **Virtual Learning Environment:**

A set of software and systems designed to manage and deliver courses electronically via the internet, providing diverse interactive tools (forums, chats, quizzes) that support the teaching and learning processes and enhance communication between the teacher and the learner (Clinch, 2005, p. 5).

The researcher procedurally defines it as: an interactive electronic platform that simulates a real classroom, allowing the learner to access multimedia educational content and engage in individual and collaborative activities using generative artificial intelligence tools and AI-supported design software.

#### **Artificial Intelligence (AI):**

A branch of computer science concerned with developing systems and software capable of performing tasks that require human intelligence, such as learning, reasoning, perception, and creativity (Russell & Norvig, 2021).

In this research, it refers to a set of software tools and applications that rely on deep learning algorithms and neural networks, capable of generating original fashion designs based on textual commands (prompts), converting drawings into prototypes, or suggesting innovative color and fabric combinations.

#### **Skills development:**

A planned change process that aimed to improving an individual's performance and raising his efficiency in performing a specific task; This is achieved through acquiring new knowledge and practicing practical applications, leading to a transition his performance level from one stage to another that is more advanced and proficient (Suzan Al-Qalini, 2007 AD, p. 14).

In this research: the goal is to provide students with the ability to effectively use artificial intelligence (AI) tools in the fashion design process, beginning from generating the idea, passing its development, and finishing with the preparation of a comprehensive presenting portfolio.

#### **Fashion designing skills using artificial intelligence:**

The set of performance abilities that enable the designer to employ artificial intelligence (AI) tools in the various stages of the designing process, includes: the skill of formulating textual commands (Prompt Engineering) to generate innovative designs; the skill of using generative designing software (such as Midjourney, DALL-E 3, and Adobe Firefly); the skill of modifying and editing outputs using graphics software (such as Photoshop and Illustrator); the skill of integrating AI-generated elements with hand-

drawn sketches; and the skill of evaluating AI outputs and selecting the most suitable ones for the designing context.

#### **Fashion Designing:**

It is the art of applying principles and elements of the design (line, color, texture, shape) to clothing and accessories, with the aim of creating garments that achieve both aesthetic and functional value. This includes the process of ideation, sketching, selecting fabrics and colors, and creating prototypes (Tortora & Merkel, 2015).

#### **Textual commands (Prompt Engineering):**

The art and science of formulating textual descriptions (keywords, adjectives, context, and artistic style) that are fed into generative artificial intelligence models to obtain accurate and innovative outputs that align with the designer's vision. This is a fundamental skill for maximizing the use of these tools (Oppenlaender, 2022).

### **2.1. Research hypotheses:**

1- There are statistically significant differences between the students' mean scores (knowledge and skill) in the virtual environment before and after the application, in favor of the post-application.

2- There are statistically significant differences between the students' mean scores in acquired knowledge (related to fashion designing using artificial intelligence) before and after the application, in favor of the post-test. This hypothesis includes the following sub-hypotheses:

2-a- There are statistically significant differences between the students' mean scores in knowledge related to the concept of artificial intelligence and its tools in fashion design before and after the application, in favor of the post-test.

2-b- There are statistically significant differences between the students' mean scores in knowledge related to writing textual commands (Prompt Engineering) before and after the application, in favor of the post-test.

2-c- There are statistically significant differences between the students' mean scores in knowledge related to evaluating and selecting the outputs of artificial intelligence before and after the application, in favor of the post-test.

3- There are statistically significant differences between the students' mean scores in acquired skills (practical performance in fashion design using artificial intelligence) before and after the application, in favor of the post-test. This hypothesis includes the following sub-hypotheses:

3-a- There are statistically significant differences between the students' mean scores in the skill of

using the Midjourney platform to generate fashion designs before and after the application, in favor of the post-test.

3-b- There are statistically significant differences between the students' mean scores in the skill of editing and modifying outputs using graphic software (Photoshop) before and after the application, in favor of the post-test.

3-c- There are statistically significant differences between the students' mean scores in the skill of integrating artificial intelligence elements with hand-drawn sketches to create a completed visualization of fashion designing before and after the application, in favor of the post-test.

## 2.2. Research methodology:

This research followed the experimental approach by One-Group Pretest-Posttest Design, as it was suitable for achieving the research objectives and verifying its hypotheses.

## 2.3. Research sample:

The research sample consisted of (30) students to develop their fashion design skills using artificial intelligence. The sample was selected purposively, taking into account they possessed basic knowledge of computer and internet use. The experiment applied during the academic year (2025/2026).

## 2.4. Research tools

1. Proposed virtual learning environment: planned and developed specifically for this research, it based on artificial intelligence (AI) applications to enhance fashion design skills.
2. Questionnaire of actual needs list: for building an AI-based virtual learning environment (Targeting experts and faculty members).
3. Cognitive achievement test (Pre/Post): to measure cognitive aspects related to fashion design using AI.
4. Practical skills test (Pre/Post): to measure students' skill performance in using AI tools for fashion design.
5. Observation card: to evaluate student's performance during the skills test and to assess their design output.

## Research limits

Objective limits: focused on developing the fundamental skills for using artificial intelligence in fashion design, including:

- Writing textual commands (Prompt Engineering) skills using a tool such as Midjourney or DALL-E 3.

- Fashion design generation skills (clothing, accessories) for various styles.
- Editing and modifying skills of outputs using Adobe Photoshop (adding colors, fabrics, and details).
- Skills for merging AI-generated elements with scanned hand-drawn sketches to create design posters.

## 3. THEORETICAL FRAMEWORK:

### 3.1. First: Virtual Learning Environments (VLEs):

Virtual learning environments are defined as software systems designed to support online teaching and learning; as they provide a comprehensive set of tools such as: content management, discussion forums, electronic tests, and synchronous and asynchronous communication tools (Clinch, 2005). They are characterized by their ability to transcend spatial and temporal limits, provide rich learning resources, and enhance interaction between learners and teachers (Bruce & Curson, 2001). Blackboard and Moodle environments are among the most well-known examples.

### Second: Artificial Intelligence in Education (AIEd):

The world is witnessing an increasing interest in employing artificial intelligence in education; as AI contributes to personalizing learning, providing immediate feedback, automating administrative tasks, and creating interactive educational content (Holmes et al., 2019). Artificial intelligence can act as an assistant teacher, an adaptive learning tool, or a producer of creative content, thereby enriching and increasing its effectiveness.

### Third: Generative AI in Fashion Design:

Diffusion models such as DALL-E 2, 3, Midjourney, and Stable Diffusion have revolutionized creative design. These models can transform textual descriptions into high-quality images, allowing designers to explore countless ideas with unprecedented speed (Rombach et al., 2022). Furthermore, specialized software such as CLO 3D and Browzwear has begun integrating AI algorithms to facilitate virtual modeling and fit testing. Särmäkari (2023) asserts that artificial intelligence does not replace the designer, but rather enhances their creative abilities, broadens their horizons, and transforms them into a creative director who manages the generation process instead of being merely a manual designer.

### Fourth: Requirements for Building an AI-Based Virtual Learning Environment:

To build such an environment, several

requirements must be met:

**Human requirements:** Faculty members trained in using AI tools and a specialized technical support team.

**Technical requirements:** A robust infrastructure consisting of high-speed internet networks, high-specification computers, subscriptions to commercial AI platforms, and a customizable e-learning platform (such as Moodle).

**Pedagogical requirements:** An instructional design that considers learner characteristics and achieve the integration between the theoretical knowledge and practical application, focusing on project-based activities and collaborative learning.

**Ethical requirements:** Establishing clear guidelines for the use of AI, emphasizing intellectual property rights, and training students in the responsible and ethical use of these tools.

### 3.2. Research Procedures:

Stages of planning and applying a virtual learning environment:

The planning process has undergone several stages, as it is a system that requires a number of sequential and interconnected practical procedures. These stages are:

#### First: Analysis Stage:

The analysis stage is considered the essential step through which the main needs and requirements for planning the learning environment are identified, along with defining the learner's characteristics and traits. The analysis stage goes through the following steps:

##### A- Identifying learner characteristics:

A survey was conducted among a sample of students in the Clothing and Textiles Department to determine their proficiency in computer and internet basics, their knowledge of the concept of artificial intelligence, and their desire to learn its use in design. The results showed great enthusiasm alongside a clear knowledge gap

##### B- Identifying needs:

**Educational needs:** Identifying the targeted skills (command writing, image generation, and editing), formulating procedural objectives, designing learning activities, and selecting appropriate teaching strategies (project-based learning, and collaborative learning).

**Technical needs:** Providing computer labs with high-speed internet access, subscriptions to the Midjourney platform (or a free alternative such as Bing Image Creator), providing Adobe Photoshop software (or free alternatives such as GIMP), and uploading content to the Moodle learning

management system.

**Financial needs:** Providing financial support for subscriptions and equipment maintenance.

#### Second: Design Stage:

##### A- Defining the overall objective of planning the virtual environment:

After identifying student needs and analyzing their characteristics, the overall objective of the virtual environment was formulated as follows:

"Designing a virtual learning environment based on generative artificial intelligence applications, with the aim of enabling students in the Clothing and Textiles Department to efficiently employ AI tools in the fashion designing process, to produce innovative and integrated designs, while developing their knowledge and skills related to textual commands (Prompt Engineering), using generative software (Midjourney, DALL-E), editing outputs with graphics software (Photoshop), and preparing design projects suitable for presentation and evaluation".

Overall objectives of the virtual environment:

After studying in this environment, the student will be able to:

1. Acquire the necessary fundamental information about the concept of artificial intelligence and its applications in fashion design.
2. Identify various tools and software used in fashion designing using artificial intelligence.
3. Understand the principles and rules of writing effective textual commands (Prompt Engineering) to achieve innovative design outputs.
4. Recognize the standards and principles necessary for evaluating and selecting AI outputs.
5. Outline the methodological steps for employing AI in the design process, from initial concept to final product.
6. Use generative artificial intelligence tools to create original fashion designs.
7. Draw and develop his designs using graphic design software in integration with AI outputs.
8. Combine traditional drawing skills with AI outputs to produce a comprehensive vision for a fashion collection.

The procedural objectives for the virtual environment:

The procedural objectives were formulated to be specific and measurable, covering both the cognitive (theoretical) and skill (performance) aspects, according to Bloom's Taxonomy of educational objectives.

**First: Cognitive Objectives:**

These objectives focus on the information, facts, and concepts that the student should acquire.

By the end of studying this virtual environment, the student will be able to:

**A- Objectives related to AI concept and tools:**

1. Define the concept of artificial intelligence and explain its importance in fashion design.
2. List the most prominent generative AI tools (Midjourney, DALL-E, and Adobe Firefly).
3. Differentiate between the characteristics of these tools in terms of ease of use and output quality.
4. Explain briefly how artificial intelligence works in converting text to images.
5. Identifying the limitations and capabilities of artificial intelligence in design (what it can and cannot do).
6. Mention the factors affecting output quality (descriptive accuracy and technical settings).

**B- Objectives related to writing textual commands (Prompt Engineering):**

1. Define the concept of Prompt Engineering and its importance.
2. List the essential components of an effective textual command (subject, description, style, lighting).
3. Explain how to formulate commands that accurately describe the type of clothing, cut, fabrics, and colors.
4. Recognize the importance of negative key words (Negative Prompts).
5. Distinguish between the impact of simple and complex commands on design quality.

**C- Objectives related to evaluating AI outputs:**

- 1- Identifying the standards for evaluating generated design (creativity, feasibility, detail accuracy).
- 2- Distinguish between feasible and non-feasible designs.
- 3- Analyze the strengths and weaknesses of generated design.
- 4- Explain the ethical and legal aspects of using AI output (intellectual property rights).

**Second: Psychomotor (Skill) Objectives**

These objectives focus on acquiring performance and practical skills.

By the end of studying this virtual environment, the student will be able to:

**A- Skills for generating fashion designs using artificial intelligence:**

1. Create an account on a generative platform and prepare to use it.
2. Write effective textual commands to generate

diverse fashion designs.

3. Employing negative keywords (Negative Prompts) to improve the quality of outputs.
4. Use upscale commands and produce variations.
5. Generate a cohesive collection of designs in a unified artistic style.
6. Employing the image-to-image tool to convert a hand-drawn sketch into a realistic design.

**B- Skills for editing and enhancing outputs using Photoshop:**

1. Use selection and isolation tools to isolate a design and change its background.
2. Applying colors adjustment layers to change the design's colors.
3. Merge elements from two different images into one using Layer Masks.
4. Adding new details (buttons and embroidery) using brushes or Generative Fill.
5. Prepare an integrated presentation board that combines multiple designs with explanatory text.

**C- Skills of integrating hand-drawing with artificial intelligence and preparing a comprehensive project:**

1. Drawing an initial idea manually and transfer it digitally.
2. Employing hand-drawing as a basis for generating enhanced versions using artificial intelligence.
3. Creating a digital Mood Board that gathers inspiration sources and outputs.
4. Producing a final, comprehensive project for a fashion collection.
5. Presenting the project, explaining the work steps and the role of artificial intelligence in each stage.

**B- Identifying and organizing virtual Environment Content:**

Identifying the content comes as a step following the defining objectives stage. The content was carefully selected to align with the objectives to be achieved; the virtual environment included:

In light of the general and procedural objectives of the virtual environment, particularly the skill-based objectives, the environment's content was designed to complement these objectives and progress from simple to complex. The following is a brief overview of the five educational units' content:

**Unit 1: Introduction to artificial intelligence in fashion design**

- The concept and development of artificial intelligence.
- Artificial intelligence applications in the

fashion industry.

- Types of tools: Midjourney, DALL-E, Adobe Firefly, and Photoshop AI.
- How generative artificial intelligence works.
- Limitations and possibilities of artificial intelligence.
- Ethical and legal aspects.

### Unit 2: The art of Prompt Engineering

• The concept and importance of Prompt Engineering.

- The essential components of an effective prompt (subject, description, fabrics, colors, style, lighting, angle, background).
- Negative Prompts.
- Advanced techniques (relative weights, compound prompt).
- Practical examples and applications.
- Exercises in writing various prompts.

### Unit 3: Practical application of generative AI tools

- Introduction to the Midjourney platform (account creation, user interface, and basic commands).
- Practical applications for generating various designs.
- Using alternative tools: DALL-E 3, Adobe Firefly.
- Advanced techniques: blending image, image-to-Image generation, seed values.
- Comprehensive practical exercises.

### Unit 4: Editing and enhancing outputs using Adobe Photoshop

- Photoshop basics (layers, and essential tools).
- Improving image quality (adjusting brightness and contrast, color correction, fixing defects).
- Isolating elements and changing backgrounds.
- Combining multiple images using Layer Masks.
- Adding details and enhancements (buttons, embroidery, texture effects).
- Using AI features in Photoshop (Generative

```

moodle@kali:~$ sudo systemctl start moodle.service
moodle@kali:~$ sudo systemctl status moodle.service
● moodle.service - Moodle Learning Management System
   Loaded: loaded (/etc/systemd/system/moodle.service; enabled; vendor preset: enabled)
   Active: active (running) since Wed 2024-03-27 10:00:00 UTC; 1min ago
     Main PID: 1234 (php-fpm)
   CGroup: /systemd/system/moodle.service
           └─ php-fpm: /usr/sbin/php-fpm --nbs --php-cgi=/usr/bin/php --php-cgid=/usr/bin/php --php-fpm

moodle@kali:~$

```

Starting Moodle backend services (command line)

Fill).

- Preparing presentations boards.
- Practical exercises.

### Unit 5: Integrating artificial intelligence with hand drawing and preparing the final project

- Hand drawing as a foundation for creativity (quick sketching techniques).
- Transferring hand drawing to the digital environment (scanning, preliminary processing).
- Using hand drawing as an input for artificial intelligence tools (Image-to-Image).
- Integrating generated elements with the original drawing in Photoshop.
- Creating a complete Mood Board and extracting a color palette.
- Preparing the final project.
- Preparing a presentation and discussing the project..



### C- Defining interaction methods:

- A weekly discussion forum for sharing designs and receiving feedback.
- Synchronous virtual discussion rooms (Zoom/Teams) for presenting projects and discussing challenges.
- Individual and group activities.

### Third: Implementation stage:

- The Moodle Learning Management System (hosted on the college server) was used as the primary platform for the virtual environment.



Moodle's first web screen: Language selection and installation



Configuring the database in the web wizard



Completing installation and administrator interface



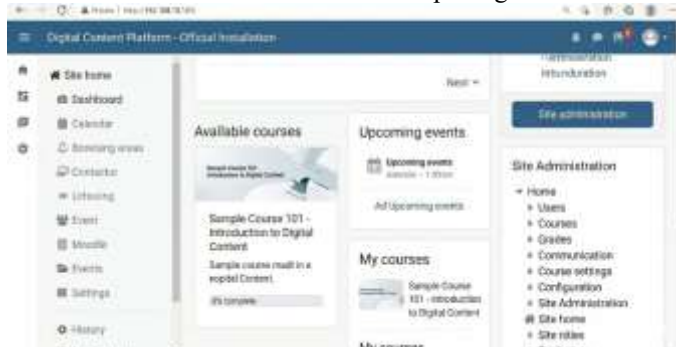
The completed Moodle interface with the first trial training course



Configuring the database in the web wizard



Completing installation and administrator interface



The completed Moodle interface with the first trial training course

The website interface was designed using Moodle tools, taking into account ease of use and visual appeal.



- Educational content has been uploaded (recorded educational videos, presentations, articles, links to AI tools).



- A training account on Midjourney was created for students via Discord, in addition to providing free alternatives.
- Pages were set up for teachers (to manage content and monitor students) and pages for students (to access content and activities).



Teachers' pages



Students' pages

#### Fourth: Environment evaluation stage:

The virtual environment and its content were presented to a group of specialized professors (2) to ensure its scientific and technical integrity and to obtain their opinions on the following elements:

- The extent to which the objectives and content

compatible with the virtual environment.

- The logical sequence of the virtual environment.
- The accuracy of the scientific approach used in the virtual learning environment.

The specialized professors unanimously approved its suitability, while offering some

suggestions. The necessary modifications were made based on these suggestions.

### **Preparing Virtual Environment Evaluation Tools:**

#### **1- A questionnaire of the actual needs list:**

The researcher prepared a questionnaire to identify the actual needs required for planning a virtual learning environment. This questionnaire was presented to a group of arbitrators consisting of specialized professors to verify the content validity of the questionnaire and its proposed items. The arbitrators provided suggestions to include additional statements, which the researcher incorporated while finalizing the questionnaire. The questionnaire included four axes: (a) Educational needs, (b) Technical needs, (c) Material needs, and (d) Security and privacy element.

#### **2- Cognitive achievement test:**

An achievement test was designed to measure the level of knowledge acquired through the virtual environment. An achievement test is a tool used to measure knowledge, understanding, and skill in a specific subject or group of subjects (Amal Sadiq & Fou'ad Abu Hatab, 1994 AD, p. 273). Information achievement test is consisted of (30) questions.

The test was organized to measure the cognitive objectives of the virtual environment to include questions to measure knowledge of the basic concepts of artificial intelligence and its tools in fashion design. It also included questions to measure knowledge of writing textual commands and questions to measure knowledge of evaluating the outputs of artificial intelligence and the ethical aspects. In developing the test items, care was taken to cover all levels of knowledge according to Bloom's Taxonomy (remembering, understanding, applying, and analyzing).

**Test Scoring:** The researcher scored the cognitive achievement test according to the scoring key, which is a form containing the number of the correct answer for each question; the marks were distributed among the questions at a rate of (1 mark) for each correct answer, thus, the total score for the achievement test is 30 points.

#### **3- Skills applied test:**

Skills applied test was designed to judge the effectiveness of the virtual environment in developing practical skills related to fashion design using artificial intelligence. Applied tests are used as objective means to evaluate the proficiency with which sensory, perceptual, and motor tasks are performed (Amal Sadiq & Fou'ad Abu Hatab, 1994, pp. 765-766). The test was designed in light of the skills objectives of the virtual environment to

measure the extent to which students acquire these skills and their ability to apply them in integrated practical contexts.

#### **Objectives of the skills applied test:**

This test aims to measure the student's ability to:

1. Efficiently using generative AI tools (Midjourney, DALL-E) to generate innovative fashion designs.
2. Employing writing textual commands (Prompt Engineering) techniques and negative keywords to obtain accurate outputs.
3. Editing and modifying the outputs using graphics software (Adobe Photoshop).
4. Integrating hand-drawn sketches with AI outputs to produce integrated design visualizations.
5. Preparing and presenting a complete fashion collection project, including display boards and technical cards.

#### **Components of the skills applied test:**

The test consists of three main tasks, aligning to the three skill groups (A, B, C), as follows:

- First task: Generating fashion designs using artificial intelligence
- Second task: Editing and modifying the outputs using Adobe Photoshop
- Third task: Integrating hand-drawn designs with artificial intelligence and preparing a complete project

#### **4- Observation Card:**

The researcher designed three observation cards, one for each part of the skills test (the three tasks), to accurately and objectively assess students' performance in light of the skills objectives of the virtual environment. These cards were prepared based on the skills targeted in groups (A, B, and C) as outlined in the procedural objectives. The observation cards were presented to a group of specialized professors to verify their content validity, their representation of the skills to be measured, and their suitability to the content. The arbitrators offered some suggestions that were considered in the final version of the cards. Also, the cards were designed to ensure a logical sequence of performing tasks, clarity of evaluation items, and ease of use for the evaluators. Each card contained a three-point rating scale, the observation card for generating designs using artificial intelligence contained (7) items, the card for editing and enhancing outputs using graphics software contained (7) items, and the card for integrating hand-drawn with artificial intelligence and preparing the final project contained (12) items.

**Scoring:** Scoring was conducted by three

specialists by placing a mark in front of the rating that applies to the item on the card, and the marks placed were translated into scores, so two points were placed for correct performance, one point for somewhat correct performance, and zero for incorrect performance.

Sincerity and reliability of research tools:

Sincerity of the questionnaire:

Sincerity has been calculated using internal consistency by calculating the correlation coefficient (Pearson correlation coefficient) between the total score of each axis and the total score for the questionnaire; and the following table shows this:

*Table (1) values of correlation coefficients between the total score of each axis and the total score of the questionnaire.*

	Correlation coefficient	Significance
First axis: Educational needs	0.881	0.01
Second axis: Technical needs	0.759	0.01
Third axis: Material needs	0.934	0.01
Fourth axis: Security element	0.807	0.01

#### Reliability of the questionnaire:

Reliability means the test accuracy in the measurement and observation, not a contradiction with itself, and its consistence in providing us with information about the examiner's behavior, and it is the ratio between the score difference on the scale, which refers to the actual performance of the examiner. The reliability has been calculated by:

1- Alpha Cronbach coefficient

2- Split-half method

*Table (2) values of the reliability coefficient for the questionnaire axes.*

Axes	Alpha coefficient	Split-half
First axis: Educational needs	0.936	0.892 - 0.971
Second axis: Technical needs	0.822	0.785 - 0.864
Third axis: Material needs	0.775	0.731 - 0.815
Fourth axis: Security element	0.914	0.872 - 0.958
Reliability of the questionnaire as whole	0.861	0.824 - 0.901

It is clear from the previous table that the all values of the reliability coefficients: the Alpha coefficient, and the Split-half are significant at the level of 0.01 and that indicates the reliability of the questionnaire.

#### Sincerity of the cognitive test:

The achievement test was presented to an arbitration commission of the specialized professors

in order to ensure the ease and clarity of the test phrases, the association of objectives with test questions. The arbitrators unanimously agreed on the validity of the achievement test for applying, offering some suggestions; the test was modified based on their suggestions.

Reliability of the cognitive test:

Reliability means that the test is coordinated in the results it gives; the reliability coefficient of the achievement test was calculated in the following ways:

#### A- Reliability using Split-half method:

The reliability of the cognitive achievement test was confirmed using the split-half method, and the correlation coefficient values were 0.753 - 0.831 for the section on the concept of artificial intelligence and its tools in fashion design, 0.862-0.944; for the section on writing textual commands (Prompt Engineering), 0.801-0.888; and for the section on evaluating and selecting the outputs of artificial intelligence, these are significant values at the 0.01 level, as they are close to the whole one, which indicates the reliability of the cognitive achievement test.

#### B- Reliability of Alpha coefficient:

It was found that the Alpha coefficient = 0.794 for the section on the concept of artificial intelligence and its tools in fashion design, 0.905 for the section on writing textual command (Prompt Engineering), and 0.842 for the section on evaluating and selecting the outputs of artificial intelligence; these are high values, which indicates the reliability of the achievement test at the 0.01 level, as the values are close to the whole one; the following table shows the reliability values.

*Table (3) Reliability of the cognitive test.*

Reliability of the cognitive test	Alpha coefficient		Split-half	
Concept of artificial intelligence and its tools in fashion design	0.794	0.01	0.753 - 0.831	0.01
Writing textual command (Prompt Engineering)	0.905	0.01	0.862 - 0.944	0.01
Evaluating and selecting the outputs of artificial intelligence	0.842	0.01	0.801 - 0.888	0.01

**Sincerity of the skill test:**

The test was presented to a group of specialized professors, and they all confirmed its validity for applying.

Reliability of the skill test (reliability of the arbitrators):

The test was marked by three specialized professors using an observation card in the evaluation process. The correlation coefficient among the three scores assigned by the arbitrators (X, Y, and Z) for the post-applied test using the rank correlation coefficient for each sample separately, and the following table shows that:

**Table (4) Correlation coefficient among the arbitrators for sections of the skill test.**

Arbitrators	Using (Midjourney) platform to generate fashion designs	Editing and modifying the outputs using graphics software (Photoshop)	Integrating AI elements with hand-drawn sketches to create a complete integrated visualization for fashion design	The skill test as whole
X, Y	0.851	0.946	0.768	0.803
X, Z	0.816	0.788	0.910	0.734
Y, Z	0.702	0.890	0.835	0.877

It is clear from the table that the values of the correlation coefficients among the arbitrators are high, which ranged (0.734-0.943), and they are significant at the level of 0.01 because they are close to the whole one, which indicates the reliability of the applied test that measures the skill performance, and also indicates the reliability of the observation card, which is the tool for correcting the skill test.

Applying the virtual learning environment

The virtual environment was applied on (30) students to develop their fashion design skills using artificial intelligence. The experiment lasted five consecutive weeks, with one day of testing per week (four hours per day), totaling (five days x four hours = twenty hours) for tests and practical training.

**First: Pre-applying stage: "Pre-application of the cognitive and skill tests":**

On the first day of the experiment (first week), the cognitive achievement test was applied to the students; as each student was required to answer all questions; and the skill tests were also applied, as

each student required to perform the test in its various parts (generating designs using artificial intelligence, editing and improving the outputs using graphics software, integrating hand-drawn sketches with artificial intelligence, and preparing the final project.

**Second: Stage of studying the educational content:**

The virtual environment content was implemented according to the five designed units.

**Third: Post-applying stage: "post-application of the cognitive and skill tests":**

After completing the learning on the fifth day (fifth week), the post-cognitive achievement test (the same as the pre-test) was applied to the students; as each student was then required to perform the post-skill test with its three tasks in full.

**Fourth: Scoring and data collection**

The researcher scored the cognitive achievement test (pre- and post-tests) according to the prepared scoring key. The post-skill application test was also scored using the observation card prepared by the researcher, and the mean scores for each student were calculated.

**4. RESEARCH RESULTS:**

**The first hypothesis:**

The first hypothesis states the following:

There are statistically significant differences between the students' mean scores (knowledge and skill) in the virtual environment before and after the application, in favor of the post-application.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

**Table (5) significance of the differences between the students' mean scores in the virtual environment before and after the application.**

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Total score of "cognitive - skill" tests
0.01 In favor of the post-application	52.138	29	30	2.021	14.821	Pre-application
				6.334	73.727	Post-application

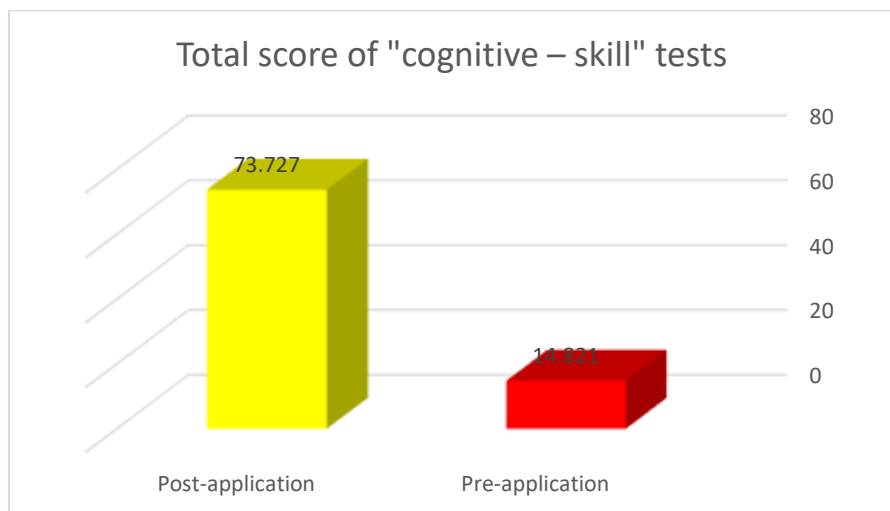


Chart (1) shows the differences between the students' mean scores in the virtual environment before and after the application

From table and chart, it is clear that the value of "t" equals "52.138", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was "73.727", while students' mean scores in the pre-application was "14.821", which indicates that there are real differences between the two applications in favor of the post-application; this means that the virtual environment is successful in achieving its goal and is indeed teaching the fundamentals it encompasses, in terms of both knowledge and skills.

To determine the effect size of the virtual environment, the Eta equation was applied: t = value of (t) = 52.138, df = degrees of freedom = 29.

$$n^2 = \frac{t^2}{t^2 + df} = 0.99$$

By calculating the effect size, it was found that  $n^2 = 0.99$ .

$$d = \frac{2 \sqrt{n^2}}{\sqrt{1-n^2}} = 19.8$$

The effect size is determined whether it is large, medium, or small as follows:

- 0.2 = small effect size
- 0.5 = medium effect size

0.8 = large effect size

This means that the effect size of the virtual environment is large, thus the first hypothesis has been verified.

**The second hypothesis:**

The second hypothesis states the following:

There are statistically significant differences between the students' mean scores in acquired knowledge (related to fashion designing using artificial intelligence) before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

Table (6) significance of the differences between the students' mean scores in acquired knowledge before and after the application.

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Total score of "Acquired Knowledge"
0.01 In favor of the post-application	32.055	29	30	1.228	4.047	Pre-application
				3.304	26.596	Post-application

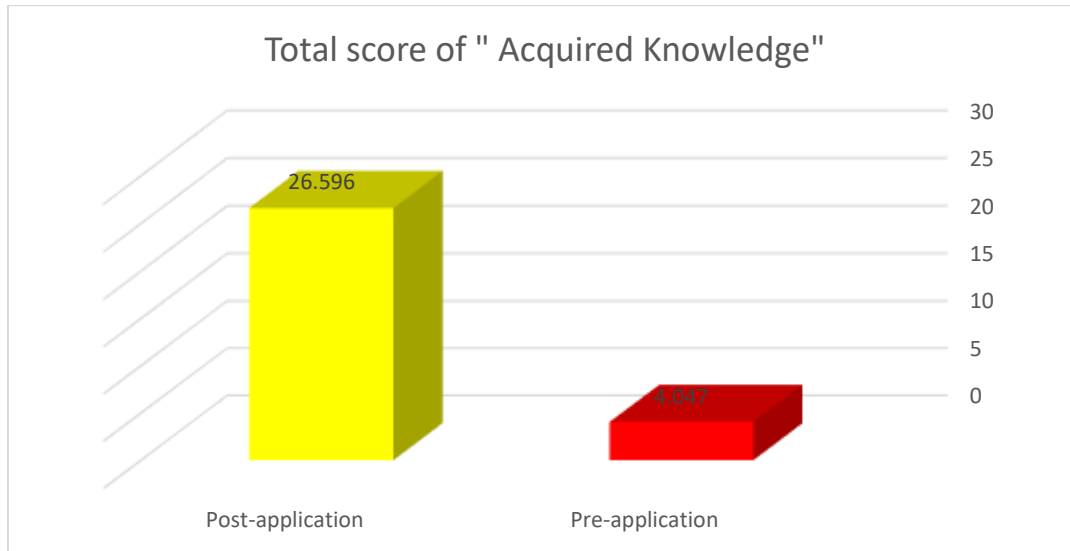


Chart (2) shows the differences between the students' mean scores in acquired knowledge before and after the application.

From table and chart, it is clear that the value of "t" equals "32.055", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was "26.596", while students' mean scores in the pre-application was "4.047", this clearly demonstrates that the students benefited from the knowledge provided within the virtual environment, thus the second hypothesis has been verified.

**Sub-hypothesis (2-a):**

The sub-hypothesis states the following:

There are statistically significant differences between the students' mean scores in knowledge related to the concept of artificial intelligence and its tools in fashion design before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

Table (7) significance of the differences between the students' mean scores in acquired knowledge related to the concept of artificial intelligence and its tools in fashion design before and after the application.

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Concept of artificial intelligence and its tools in fashion design
0.01 In favor of the post-application	12.663	29	30	0.881	2.004	Pre-application
				1.267	9.523	Post-application

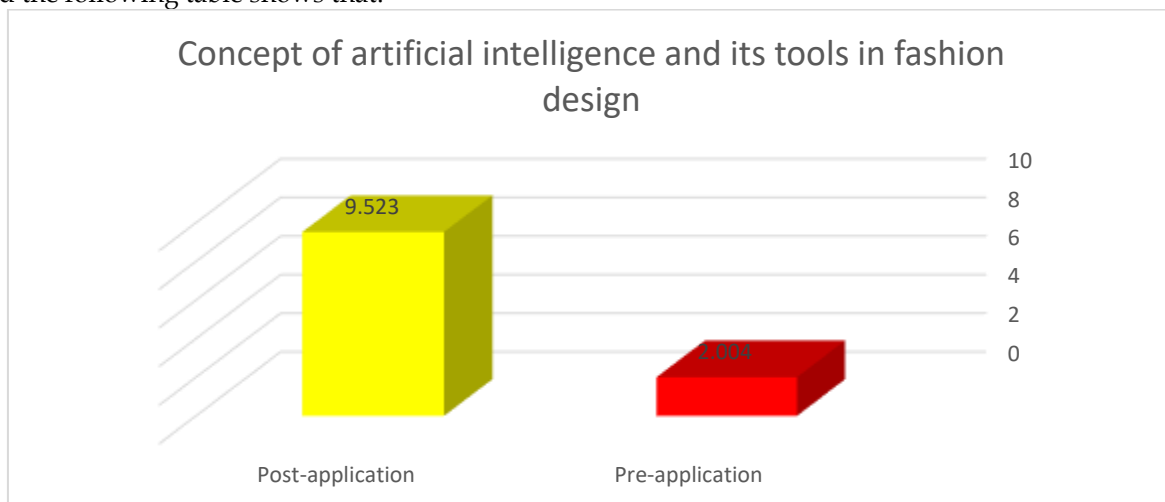


Chart (3) shows the differences between the students' mean scores in acquired knowledge related to the concept of artificial intelligence and its tools in fashion design before and after the application

From table and chart, it is clear that the value of "t" equals "12.663", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was "9.523", while students' mean scores in the pre-application was "2.004", thus the Sub-hypothesis "2-a" has been verified.

**Sub-hypothesis (2-b):**

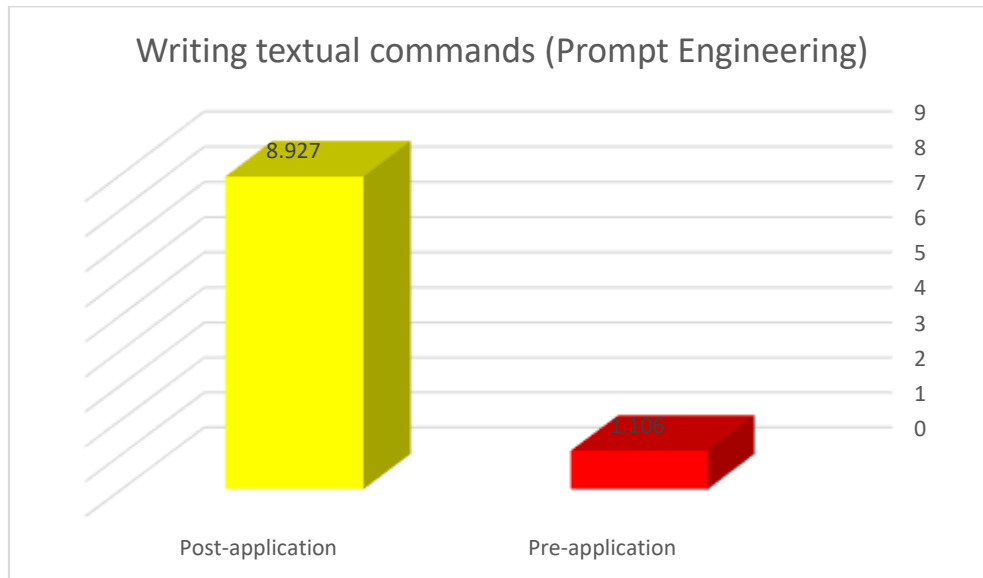
The sub-hypothesis states the following:

There are statistically significant differences between the students' mean scores in knowledge related to writing textual commands (Prompt Engineering) before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

**Table (8) significance of the differences between the students' mean scores in acquired knowledge related to writing textual commands (Prompt Engineering) before and after the application.**

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Writing textual commands (Prompt Engineering)
0.01 In favor of the post-application	10.244	29	30	0.523	1.106	Pre-application
				1.318	8.927	Post-application



**Chart (4) shows the differences between the students' mean scores in acquired knowledge related to writing textual commands (Prompt Engineering) before and after the application.**

From table and chart, it is clear that the value of "t" equals "10.244", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was "8.927", while students' mean scores in the pre-application was "1.106", thus the Sub-hypothesis "2-b" has been verified.

**Sub-hypothesis (2-c):**

The sub-hypothesis states the following:

There are statistically significant differences between the students' mean scores in knowledge related to evaluating and selecting the outputs of artificial intelligence before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

**Table (9) significance of the differences between the students' mean scores in acquired knowledge related to evaluating and selecting the outputs of artificial intelligence before and after the application .**

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Evaluating and selecting the outputs of artificial intelligence
0.01 In favor of the post-application	9.691	29	30	0.235	0.937	Pre-application
				1.403	8.146	Post-application

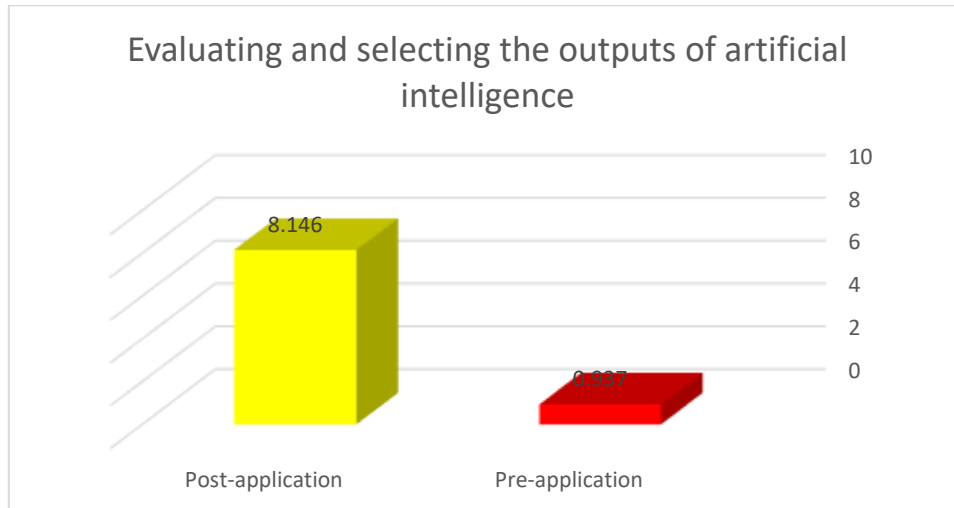


Chart (5) shows the differences between the students' mean scores in acquired knowledge related to evaluating and selecting the outputs of artificial intelligence before and after the application

From table and chart, it is clear that the value of "t" equals "9.691", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was "8.146", while students' mean scores in the pre-application was "0.937", thus the Sub-hypothesis "2-c" has been verified.

**The third hypothesis:**

The third hypothesis states the following:

There are statistically significant differences between the students' mean scores in acquired skills (practical performance in fashion design using artificial intelligence) before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

Table (10) significance of the differences between the students' mean scores in acquired skills before and after the application.

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Total score of "Acquired Skills"
0.01 In favor of the post-application	35.416	29	30	1.450	10.774	Pre-application
				4.037	47.131	Post-application

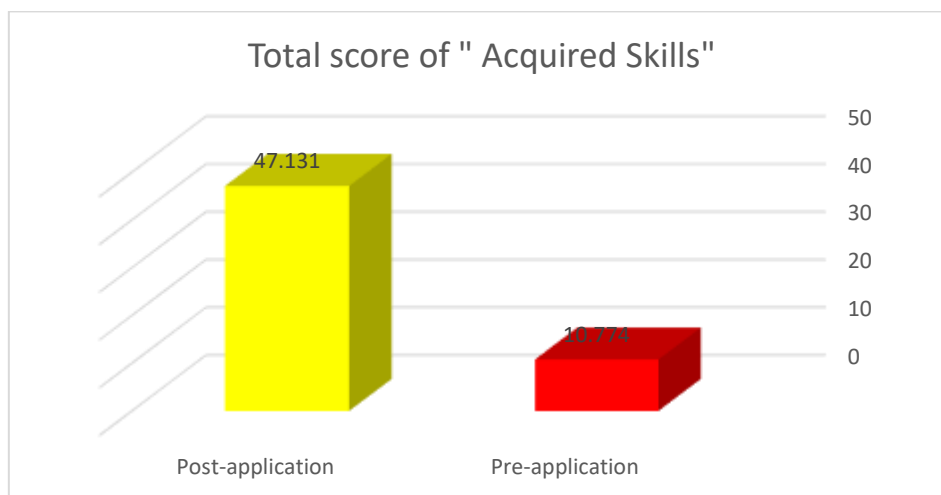


Chart (6) shows the differences between the students' mean scores in acquired skills before and after the application.

From table and chart, it is clear that the value of "t" equals "35.416", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post- application was

"47.131", while students' mean scores in the pre-application was "10.774", this clearly demonstrates that the students benefited from the skills provided within the virtual environment, thus the third

hypothesis has been verified.

**Sub-hypothesis (3-a):**

The sub-hypothesis states the following:

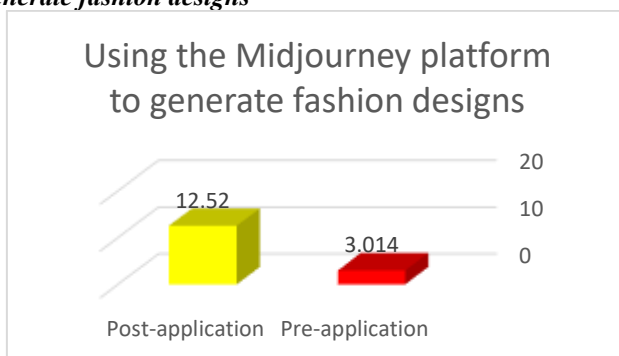
There are statistically significant differences between the students' mean scores in the skill of using the Midjourney platform to generate fashion designs before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

**Table (11) significance of the differences between the students' mean scores in acquired skill related to using the Midjourney platform to generate fashion designs**

*before and after the application.*

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Using the Midjourney platform to generate fashion designs
0.01 In favor of the post-application	16.387	29	30	0.986	3.014	Pre-application
				1.892	12.520	Post-application



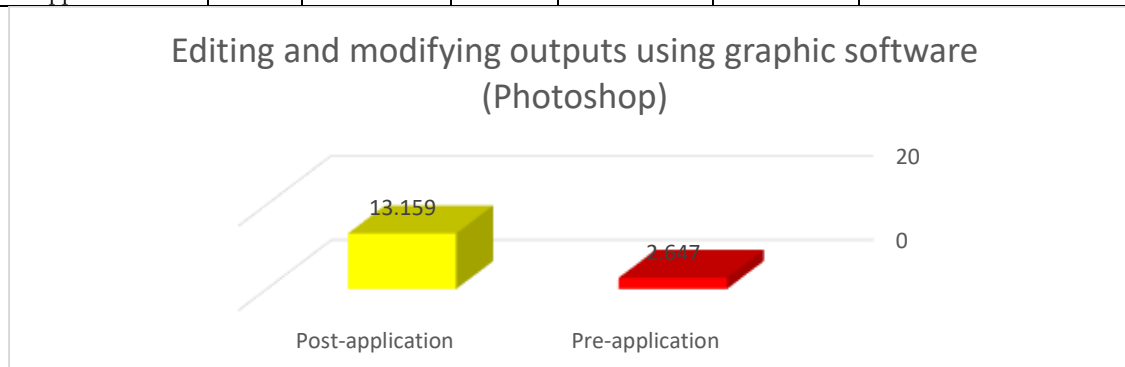
**Chart (7) shows the differences between the students' mean scores in acquired skill related to using the Midjourney platform to generate fashion designs before and after the application.**

From table and chart, it is clear that the value of "t" equals "16.387", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post-application was "12.520", while students' mean scores in the pre-application was "3.014", thus the Sub-hypothesis "3-a" has been verified.

**Sub-hypothesis (3-b):**

**Table (12) significance of the differences between the students' mean scores in acquired skills related to editing and modifying outputs using graphic software (Photoshop) before and after the application.**

Significance level & its direction	Value of (t)	Degrees of freedom "df"	Sample Size "N"	Standard Deviation "SD"	Arithmetic Mean "M"	Editing and modifying outputs using graphic software (Photoshop)
0.01 In favor of the post-application	14.207	29	30	0.872	2.647	Pre-application
				1.530	13.159	Post-application



**Chart (8) shows the differences between the students' mean scores in acquired skills related to editing and modifying outputs using graphic software (Photoshop) before and after the application.**

From table and chart, it is clear that the value of "t" equals "14.207", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post-application was "13.159", while students' mean scores in the pre-application was "2.647", thus the Sub-hypothesis "3-b" has been verified.

**Sub-hypothesis (3-c):**

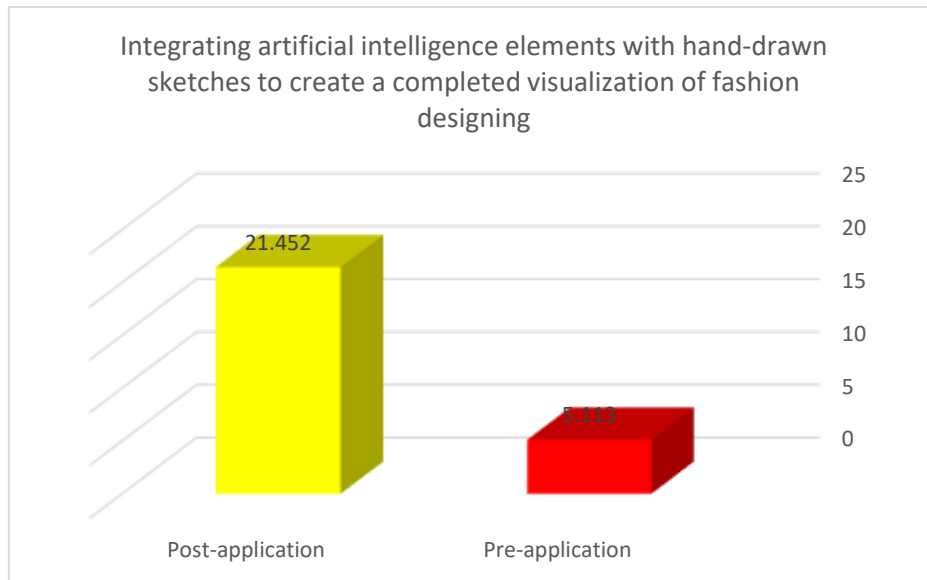
The sub-hypothesis states the following:

There are statistically significant differences between the students' mean scores in the skill of integrating artificial intelligence elements with hand-drawn sketches to create a completed visualization of fashion designing before and after the application, in favor of the post-test.

To verify this hypothesis, the (t) test was applied; and the following table shows that:

**Table (13) significance of the differences between the students' mean scores in acquired skills related to integrating artificial intelligence elements with hand-drawn sketches to create a completed visualization of fashion designing before and after the application.**

Integrating artificial intelligence elements with hand-drawn sketches to create a completed visualization of fashion designing	Arithmetic Mean "M"	Standard Deviation "SD"	Sample Size "N"	Degrees of freedom "df"	Value of (t)	Significance level & its direction
Pre-application	5.113	1.001	30	29	23.087	0.01 In favor of the post-application
Post-application	21.452	2.869				



**Chart (9) shows the differences between the students' mean scores in acquired skills related to integrating artificial intelligence elements with hand-drawn sketches to create a completed visualization of fashion designing before and after the application.**

From table and chart, it is clear that the value of "t" equals "23.087", and it is statistically significant at the level 0.01 in favor of the post-test, where the students' mean scores in the post-application was "21.452", while students' mean scores in the pre-application was "5.113", thus the Sub-hypothesis "3-c" has been verified.

**5. DISCUSSION OF RESULTS**

The results of this research are consistent with those of previous studies that confirmed the effectiveness of virtual learning environments in

developing knowledge and skills (Chou, 2005; Amal Nasr El-Din, 2008). They are also consistent with recent studies that indicated the importance of integrating artificial intelligence into design education to enhance creativity and innovation (Särmäkari & Vänskä, 2022; Giri et al., 2023). These results can be interpreted in light of the following:

Interactivity and practical application: The virtual environment allowed students to interact directly with AI tools, experiment with different textual commands, and see the results immediately; this enhanced learning through discovery and experimentation.

**Project-based learning:** The final project (designing a fashion collection) helped in integrate and use various skills within a real-world context, which increased student motivation and improved the quality of their outputs

**Continuous support and guidance:** The environment (through forums and live sessions) provided immediate feedback and collaboration among students, contributing in improving their performance.

**The novelty and importance of the topic:** Students demonstrated great enthusiasm for learning these new skills, which positively influenced their engagement and enabled them to achieve outstanding results.

### 5.1. Research recommendations:

1. The need to redesign the curricula in clothing and textile departments to include educational modules on artificial intelligence and its applications in fashion design.
2. Establishing permanent virtual learning environments in colleges, supported by artificial intelligence tools, to serve as digital laboratories for students to practice modern design skills.



A realistic, full-body photograph of a contemporary evening dress. The bodice is made of interwoven silk pieces in a shimmering sapphire blue; resembling waves. The skirt is made of layers of sky-blue organza and tulle, with delicately embroidered with waves motifs in deep blue and turquoise. The gown is sleeveless, with a high collar and a long train. Soft, warm light from the left illuminates the fabric's details. Cinematic lighting, accurate

3. Providing intensive training for faculty members on the use of generative AI tools and how to employ them in teaching and project supervision.
4. Establishing partnerships with technology companies (such as OpenAI and Adobe) to obtain discounted licenses for students and faculty members, and to provide a rich learning environment.
5. Conducting further research to study the impact of artificial intelligence on other aspects of fashion design learning, such as creativity, problem-solving, and critical thinking.
6. Developing a code of ethics for the use of artificial intelligence in academia that respects intellectual property rights and encourages responsible use.
7. Planning to establish a fully integrated "virtual fashion factory" that simulates the production stages, starting from designing using AI, passing through virtual modeling, and finally, electronic marketing.

### 5.2. Samples of students' work

Writing effective textual commands to generate diverse fashion designs.



A detailed close-up of a contemporary evening dress. The bodice and skirt are designed from reflective silver technical fabric, integrating LED light strips that glow in light sky blue and purplish color, these strips forming geometric patterns. The gown features a high collar. The model stands in front of a concrete showcase wall with simple texture. High quality, incredibly realistic - ratio of width to height is 3:4.

details, and high resolution - ratio of width to height is 3:4.



A realistic, full-body photograph of a contemporary evening dress. The fabric is a complex weave of sustainable metallic fibers in silver and copper, interwoven with soft, luminous blue and purple strips. The gown is collarless. The model stands in front of a concrete showcase wall with simple texture. High quality - ratio of width to height is 3:4.



A detailed close-up of a contemporary dress inspired by shades of purple and crystalline brown. The fabric is composed of multi-faceted, stiff panels and lustrous silk, simulating crystalline formations. The dress's train flows dramatically. The photograph was taken in front of a warm showcase wall with simple design. High quality, incredibly realistic - ratio of width to height is 3:4.





*Generator tool (Image-to-Image) for converting hand-drawn sketch into realistic design*



*Generating an interrelated collection of designs in a unified artistic style*





*Skills of editing and enhancing outputs using graphic design software (Photoshop)*



The student isolated the dress from its background using a precise selection tool and placed it on a new background.



The student created a "Hue/Saturation" adjustment layer to change the color of a specific part of the dress.



The student put a new layer containing a fabric (lace) over the base layer of the dress.

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