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The effectiveness of blended learning models (flexible/flipped) on developing animation video production skills for professional diploma students

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Abstract

The current research aims to investigate the effectiveness of blended learning models (flexible/flipped) in developing animation production skills for students of the Professional Diploma in Educational Technology. The main experiment was conducted on a sample of 20 students enrolled in the Professional Diploma in Educational Technology at the Faculty of Education, Tanta University, during the second semester of the 2022/2023 academic year. The sample was divided into two groups, each consisting of 10 students. The blended learning environments (flexible/flipped) were designed according to the modified instructional design model of Abdel Latif Al-Jazzar (2013). The results revealed the superiority of the flipped blended learning group over the flexible blended learning group. This was evident in the post-test of both the cognitive achievement test and the skill performance observation checklist related to animation production skills. roduction skills. The study recommended utilizing blended learning models to enhance learners' knowledge and skills, improve their understanding of scientific concepts, and elevate their mastery in animation production.

Keywords: *blended learning – flexible – flipped - Animation video - Professional diploma students*

Introduction

The Modern technology and reliance on e-learning cannot be ignored on one hand, while on the other hand, traditional learning has numerous advantages that make it difficult to completely dispense with, despite its shortcomings. Hence, there arises the need for an approach that combines the advantages of both traditional learning and e-learning, which is blended learning.

Both Staker (2011) and Henderson (2017) agreed that blended learning involves integrating e-learning methods and tools with traditional (face-to-face) learning methods and tools within the classroom setting of an educational institution. This approach delivers information and fosters interaction among the key elements of the educational process (teacher and learner). Thus, it becomes clear that blended learning is an application of traditional educational strategies enhanced by modern technological advancements. It relies on combining two or more distinct learning methods, integrating traditional classroom learning with online learning methods and technological innovations.

The importance of blended learning is evident from the preceding discussion, which has led to numerous attempts in recent years to develop and classify it into several models. These models aim to suit different learning environments within educational institutions and cater to individual differences among learners across various educational stages. Accordingly, Staker (2011) proposed six models of blended learning: Face-to-Face Driver, Rotation Model, Flex Model, Online Lab, Self-Blend, and Online Driver. Furthermore, Staker et al. (2013) refined

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these six blended learning models after applying them in various educational institutions across the United States, conducting interviews with many educators, analyzing the results, and validating them through the Innosight Institute. This process resulted in four blended learning models classified under two main categories: Traditional Learning and Online Learning (Powell et al., 2015, pp. 6-7).

Blended flexible learning is an educational model that offers students the flexibility of learning in terms of time, place, and methods of content delivery. It integrates e-learning with communication between students and the teacher through synchronous and asynchronous online tools. Additionally, it provides face-to-face support upon learners' requests to facilitate the learning process. In this model, students engage in learning, perform individual and group activities, and complete online assessments remotely via the internet. Meanwhile, the teacher provides face-to-face support to address individual and group issues of the students. (Goldrick et al., 2015; Jason et al., 2016)

The concept of blended flipped learning, also known as the 'flipped classroom,' is a form of blended learning that reverses the traditional educational process. Blended learning relies on two main types of activities: interactive group learning activities within the classroom and individual learning activities using computers outside the classroom. This definition indicates that lectures and explanatory videos are mandatory elements of activities outside the classroom, alongside other types of learning resources such as podcasts, slides, articles, and lecture notes, which are made available alongside videos. In the classroom, interactive activities are conducted, including exercises, training, discussions, problem-solving, tests, enhancing social interactions, and holding Q&A sessions. (Abeysekera & Dawson, 2015; Cevikbas, 2018; Cevikbas & Kaiser, 2021; Talbert, 2015)

E-learning tools vary widely to achieve the desired learning outcomes and to be utilized in ways that serve the educational process, helping learners gain experiences through diverse methods and forms. These tools include blogs, social media networks, online video platforms, learning management systems, and other e-learning tools. They are characterized by their participatory content and focus on making the student the center of the educational process. Modern learning strategies rely heavily on videos of various types, highlighting the importance of developing video production skills in general and interactive animated video skills in particular, given their significant capabilities in various fields of learning.

In the context of developing animated video production skills, Ploetzner et al. (2020) emphasized that animation is a comprehensive term for the art of motion in both two-dimensional and three-dimensional forms. An animated video consists of a series of drawings, each slightly different from the one before and the one after it. In other words, the sequence of drawings represents different stages of a segmented motion, recorded sequentially on video (frame by frame). When the film is played on screen, these drawings create the illusion of continuous movement.

Apriansyah and Sambowo (2020) emphasized that educational tools in the form of interactive animated video clips are among the resources that can be used in the learning process. Interactive animated video is widely accepted as a medium for teaching materials, being one of the most common and popular audiovisual tools among both children and adults, in both large cities and small towns. Video is closely tied to people's daily lives and is used to meet a general need—to convey an idea, message, or fact. Due to its unique dimensions, video has been proven to be significantly better than other mediums in terms of memory retention and its ability to influence students' emotions.

Literature Review:

The First Topic (The Flipped Classroom):

Blended Learning Models:

Blended learning combines traditional face-to-face instruction with online learning components. This approach offers flexibility in learning, allowing students to engage with content both in-person and remotely. According to Horn and Staker (2015), blended learning can be divided into several models, which can be categorized under two main types: Brick-and-Mortar and Online Learning.

1. **Brick-and-Mortar Models:**
    a. **Station Rotation Model**: In this model, students rotate through different learning stations, typically within a single classroom or group of classrooms. All students rotate through every station, regardless of their individual schedules (Horn & Staker, 2015).
    b. **Flex Model:** This model allows students to move through material at their own pace, often with a mix of online learning tools and in-person support as needed.

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2. **Online Learning Models:**
    a. **Self-Blended Model (À la Carte)**: In this approach, students take additional online courses to supplement their in-person schooling. The model provides flexibility for students to engage in both traditional and online learning experiences (Horn & Staker, 2015).
    b. **Enriched Virtual Model**: In this model, students complete most of their learning in an online environment but periodically attend face-to-face sessions for additional support or assessments.

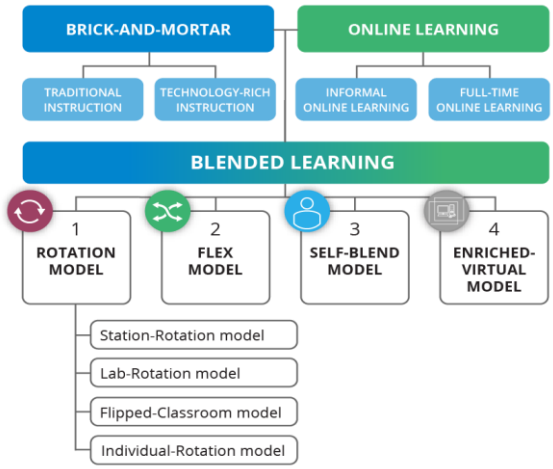

Figure 1
Latest update of blended learning models (2015) Horn and Staker

Below is a detailed presentation of the two blended learning models (flexible/flipped):

Flexible Blended Model:

Suner (2015), Lucia (2016), and Jamaluddin et al. (2023) emphasized that the Flexible Blended Learning Model primarily relies on online learning. In this type of learning, the teacher provides course content, self-assessments, and final exams online for the students. The teacher also offers individual and group activities, as well as electronic communication tools between the teacher and peers, and among peers themselves. This allows students to participate in small and large groups and to submit projects and assignments electronically. This model provides students with the freedom of time and place for study. Teachers can support students within the classroom according to their needs and abilities. It is no longer necessary for all students to attend at a specific time to meet the teacher face-to-face. Sometimes, students meet with the teacher or with each other in the classroom to provide support on projects and to fill in gaps related to the same topic or project.

In this context, numerous studies and experiments have confirmed the effectiveness and importance of the flexible blended learning model, as evidenced by the following:

Horn and Staker (2015) indicated that Flex Academy in San Francisco, USA, implemented the flexible blended learning model in elective courses for twelfth-grade students. Students studied these courses, completed projects, and took tests online, with face-to-face support from teachers based on individual student needs. The results revealed an enhancement in students' academic achievement and project production skills.

Kristin (2019) conducted a study to evaluate the impact of the flexible blended learning model on student engagement and mastery in history by studying a unit on the Enlightenment and various revolutions. The experiment lasted for six consecutive weeks, and after completing the study, data collection, including pre- and post-tests and Likert scale surveys, was discussed and analyzed. The study results confirmed that students were able to acquire skills in comprehension, mastery, and engagement.

Flipped Blended Model:

Jason et al. (2016, 42) and Mattis (2015, 238) argue that the flipped classroom reverses the roles of school and home. In this model, students study course content online in the form of videos and lectures before attending the classroom. They also take self-assessments through an online platform. This approach gives students the freedom to choose the time and place that is suitable for them to study the content and complete the assessments. Additionally, students engage in individual and group activities in the classroom according to a schedule, under the teacher's supervision. They practice practical skills and participate in classroom discussions under the guidance of the teacher.

This context, numerous studies have highlighted the effectiveness of the blended flipped learning model, as illustrated below:

Rozniza (2023) conducted a study to compare the effectiveness of flipped classrooms and traditional methods in delivering programming courses and developing problem-solving skills. The study involved a sample of 28 students divided into two groups: 14 students were taught using the flipped classroom model, while 14 students were taught through traditional methods. The results demonstrated the superiority of the flipped classroom strategy in learning programming and

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enhancing problem-solving skills compared to the traditional method.

Khairunnisak et al. (2023) conducted a study aimed at determining the effectiveness of the flipped classroom system in developing students' critical thinking skills. The study included a sample of 71 students divided into a control group and an experimental group. The results showed that the flipped classroom effectively enhances students' critical thinking skills.

The definition of blended learning models (flexible / flipped):

The blended learning models (flexible/flipped) are among the most prevalent and important terms in the field of learning. Researchers have expressed varying views on defining each model, and literature and studies have provided multiple perspectives on their concepts, which can be explained as follows:

The definition of flexible blended learning style:

Many definitions have focused on describing the learning process in a flexible blended learning environment, how it occurs, and the technological techniques used in it.

Simonova (2014) stated that flexible blended learning is "a type of blended learning implemented through an online educational platform, which provides educational resources, teacher support for students, problem-solving, and project production, while also offering face-to-face support from the teacher and peers when learners need it".

Kagwiria (2015) explained that flexible blended learning is "the employment of modern technological techniques in delivering content, information resources, learning activities, and assessment methods, while also allowing for face-to-face interaction in classrooms with the teacher and peers when educational guidance is needed at the learners' request.

Chmiel et al. (2017) clarified that flexible blended learning is "a type of blended learning that provides learners with the flexibility to learn through an online learning platform that offers them learning content and spaces for conducting educational activities, along with face-to-face support in classrooms with the teacher and peers according to their needs".

The definition of flipped classroom:

Researchers have expressed various opinions regarding the concept of the Flipped Blended Learning Model, and many definitions have emerged in research papers, books, and studies. These can be summarized as follows:

Many definitions of the flipped classroom concept have focused on the changes in teaching methods and the flipping of the educational process, as well as the role of modern technologies used within it. For instance, Davies et al. (2013) defined it as "a model of blended learning based on teaching students outside the classroom through educational videos via the internet, while dedicating class time for the teacher to answer students' questions and address any problems they may have encountered while trying to understand the material during their video viewing, as well as conducting various collaborative activities."

Swithenbank and Denucci (2014) describe the flipped classroom as "an educational model aimed at using modern technologies in a way that allows the teacher to prepare the lesson through video clips, audio files, or other multimedia, for students to review at home before attending class. Meanwhile, class time is dedicated to active learning, conducting exercises, and collaborative projects to enhance students' understanding of the subject matter."

Mattis (2015) adds that it is "a model of blended learning that reverses the roles of home and school, allowing each to take on the role of the other in the educational process. This is done by moving the traditional lecture from class time to outside of it, where students rely on watching educational videos at their own pace and at a suitable time, while utilizing class time for student engagement in group activities."

Adonu et al. (2021) define the flipped classroom as "a form of blended learning that enhances student learning outside the classroom in remote education. It is the method by which students watch recorded lesson videos outside of class during their free time, studying at their own pace, and then participate in practical activities that they perform during class".

Characteristics of Blended Learning Environment

1. **Flexibility**:
    a. Students can learn at their own pace and schedule. This flexibility allows for a personalized learning experience, accommodating different learning styles and schedules. (Garrison & Vaughan, 2008).
    b. The integration of online resources provides learners with various options to access materials anytime and anywhere (Graham, 2006).
2. **Active Learning:**
    a. A flipped classroom model encourages students to engage with course content before class, often through videos or readings, freeing up class time for

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interactive, hands-on activities (Bergmann & Sams, 2012).

b. This approach fosters higher-order thinking and collaborative learning, as students can work on projects or engage in discussions during face-to-face sessions (Miller, 2014).

3. **Integration of Technology:**
   a. Technology plays a critical role in blended learning environments, facilitating access to online resources, communication tools, and collaborative platforms (Picciano, 2017).
   b. Tools such as Learning Management Systems (LMS) help in organizing course content and tracking student progress (Baker, 2013).
4. **Instructor Role:**
   a. Instructors shift from being the primary source of information to facilitators of learning, guiding students in their exploration and understanding of the material (Baker, 2013).
   b. They provide support and feedback through online platforms, helping students to navigate their learning paths effectively (Bergmann & Sams, 2012).
5. **Personalized Learning:**
   a. Blended learning allows for differentiated instruction, where teachers can tailor activities to meet the diverse needs of students (Graham, 2006).
   b. Students can set their own goals and reflect on their learning processes, promoting self-directed learning (Garrison & Vaughan, 2008).
6. **Collaborative Learning:**
   a. Online discussion boards, group projects, and peer assessments encourage collaboration among students, enhancing their social learning experiences (Miller, 2014).
   b. Students can connect with peers and instructors, fostering a sense of community despite the physical separation (Picciano, 2017).

The second topic (Animation Video):

The definition of Animation Video:

The definitions of animation have varied. Glucksman, Andre (2000) defines it as a series of images that move at a certain speed to trick the human eye into perceiving motion, relying on optical illusion. Paul (2019) defines animation as "the process of creating moving images by sequentially arranging static images or drawings, displayed at a certain speed to give the illusion of motion. This effect can be achieved through various techniques, such as hand-drawn animation, computer-generated imagery (CGI), stop-motion animation, and more. Animation is used in films, TV shows, advertisements, and video games, and is considered a powerful tool for storytelling and conveying ideas in a visually appealing and engaging way". Maio (2023) defines animation as: "A method of capturing sequential drawings, models, or even puppets to create the illusion of movement in a sequence. Since our eyes can only retain an image for about 1/10 of a second, when multiple images appear in rapid succession, the brain merges them into a single moving image."

Features and Advantages of Animation in Education:

Oktarina (2015), Yilmaz and Baydas (2016), Mansor et al. (2020), Shuo (2021), and Stadlinger (2022) pointed out several features and characteristics of animations, including:

1. Creating an alternative to reality, such as past historical events, scientific events, cosmic events, or future events. Still images (if available) fail to achieve the effectiveness that animations provide when displayed. For example, an animation showing the planets of the solar system revolving in their orbits around the sun, with each planet rotating according to its specific speed relative to the others. Simply by watching, one can easily understand the rotational speed of each planet in comparison to the others.
2. Representing abstract reality, where animations provide a tangible and concrete representation of concepts that are difficult to perceive with the senses. For instance, the movement of the planets in the solar system or the motion of electrons in an atom can be visualized, as well as the invasion of microbes in the human body and the body's defense against them.

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3. The capacity for imagination that is not constrained by familiar natural laws; for example, a character falling from an airplane only to rise again and continue chasing their enemy, and the graph line representing cotton yields that is suddenly interrupted by a pest, causing it to stop rising, only for the farmer to intervene with pesticides and eliminate the threat, allowing the line to rise again.
4. Deepening the knowledge acquired by learners; as animations have a significant impact on the cognitive development of learners, contributing greatly to enhancing and elevating cognitive skills.
5. Visual and cognitive effects support learners; as Ladislav (2020) emphasizes the necessity of using interactive educational tools in the teaching process, particularly animations.
6. They assist learners in the process of discovering underlying meanings during learning; animations help teachers overcome certain problems that traditional educational tools cannot resolve during the teaching process.
7. The ability to present continuity in movement; it provides an alternative to actual motion that resembles it in overall appearance and ongoing development. The capability of animations to depict movement in its realistic form enhances the meanings conveyed, which is better than presenting still images or drawings.
8. Interpreting and clarifying events; animations interpret movement in various ways, each suited to a specific scientific objective, such as viewing reality from a new angle that offers a fresh interpretation, or repeating the actual motion when it is necessary to observe the event multiple times for comprehension and study, or to control the speed of presentation.
9. Controlling the speed of the presentation of reality for clarification, persuasion, or study; this can be achieved by slowing down or speeding up the sequence of its stages on the screen in front of the viewer.
10. Accelerating the learning process; animations help reduce learning time, as confirmed by Hoffler's (2007) study, which demonstrated that animations contribute to decreasing the time allocated for the learning process by 95%.

Aims and Research Questions

This research aims to know the effect of the two blended learning patterns (flexible/flipped) on developing the cognitive and skill aspects of producing animated videos, and to determine the appropriate educational design model for developing animation production skills, The research problem was formulated through the following main question:

What is the effectiveness of an electronic environment based on blended learning models (flexible / flipped) in developing animation video production skills for professional diploma students?

The following sub-questions branch out from the main question:

1. What is the list of animation video production skills that should be acquired by professional diploma students in educational technology?
2. What is the list of design standards for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?
3. What is the proposed instructional design for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?
4. What is the effectiveness of an electronic learning environment based on blended learning models (flexible/flipped) in developing the cognitive aspect of animation video production skills for professional diploma students?
5. What is the effectiveness of an electronic environment based on blended learning models (flexible/flipped) in developing the performance aspect of animation video production skills for professional diploma students?
6. What is the effectiveness of an electronic environment based on blended learning models (flexible/flipped) on the quality of animation video products created by professional diploma students?

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Research Objectives:

The current research aims to:

1. Identify the skills needed for producing interactive animation videos suitable for professional diploma students.
2. Develop a list of design criteria for blended learning environments (flexible/flipped).
3. Select the appropriate instructional design model for the blended learning environments (flexible/flipped).
4. Determine the design components for the blended learning environments (flexible/flipped).
5. Create a blueprint for designing a blended training program (flexible/flipped) that can be used to develop animation video production skills.
6. Examine the impact of the two types of blended learning (flexible/flipped) on the cognitive and practical aspects of producing animation videos.
7. Identify the most effective type of blended learning (flexible/flipped) for enhancing the cognitive and practical aspects of interactive animation video production and fostering creative thinking among professional diploma students.

Importance of research:

1. It is one of the developmental researches in the field of educational technology, as it is based on designing a training program that adopts a model for designing two blended learning environments (flexible / flipped).
2. This research can contribute to providing designers and developers of educational environments with a set of scientific principles and foundations when designing two blended learning environments (flexible / flipped).
3. Providing a list of criteria for designing a training program based on two blended learning environments (flexible / flipped).
4. Benefit from the relationship between the variables of the current research and the possibility of employing them in other research.
5. A- Providing learning environment designers with a set of foundations, principles and scientific foundations when designing blended learning environments (flexible / flipped).
6. Preparing tools to measure animation video production skills.
7. The results of the current research may contribute to educational institutions adopting new patterns and tools for designing blended learning environments, to improve learning outcomes in various fields.
8. Emphasizing the use of active, collaborative and participatory learning strategies in learning activities within training programs based on various blended learning environments.
9. Directing the attention of the parties responsible for training teachers and educational technology specialists to the importance of developing animation video production skills.
10. Helping educational institutions develop curricula and employ animation video in education.

Limits of research:

The current research was limited to the following limits:

1. Human limits; A sample of students of the Professional Diploma in Educational Technology at the Faculty of Education.
2. Tanta University.
3. Time limits; The research was applied at the Faculty of Education, Tanta University.
4. Temporal limits; The research was applied in the academic year (2022/2023).
5. Objective limits: The current research is limited to developing the cognitive and skill aspects of producing animation video.

Research methodology:

Systemic development approach:

By applying the educational design model of Abdul Latif Al-Jazzar (2013) to design an electronic learning environment based on the two models of blended learning (flexible / flipped).

The descriptive-analytical approach:

This approach was adopted in the current research to prepare the theoretical framework and previous studies and research related to the research variables, by analyzing studies and literature relevant to the research problem and its variables. This was used to determine the criteria and components for designing an electronic learning environment based on blended learning models

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(flexible/flipped) and research tools, as well as the relationship between the research variables, in addition to interpreting and discussing the research findings.

The quasi-experimental approach:

To determine the effectiveness of the independent variable with two levels on the development of the dependent variable.

Method:

Research Design:

According to the independent variable of the current research, which has two levels, the current research uses a (1×2) design to develop the dependent variable (animation video). The research sample is divided into two experimental groups as follows:

1. The first group: Professional diploma students who studied using the flexible blended learning model.
2. The first group: Professional diploma students who studied using the flipped blended learning model.

Participants:

The research sample was selected, consisting of students from the Professional Diploma in Educational Technology at the Faculty of Education, Tanta University, for the academic year (2022/2023). All participants hold higher qualifications (Bachelor's degrees in Arts/Education) in various specializations. The research sample falls within the age group of 22 to 34 years. The research sample was then divided into two experimental groups, each consisting of 10 students, all of whom needed to develop skills in producing animated video content, as shown in the table below:

Table 1*Division of the Research Sample According to the Independent Variable*

Learning style	Groups members	Total students
Flexible blended learning	10	20
Flipped blended learning	10	

The prior learning of the research sample was identified through the application of research tools in advance, which indicated a deficiency in the cognitive aspects and performance skills related to animated video production skills among the sample. However, they possess the basic requirements for the study, which include a set of computer handling skills.

Instruments and Data Collection Procedure

Personal Observation:

The awareness of the research problem arose from the researcher's observations during the practical application of the master's thesis on a sample of graduate students in the Educational Technology department at the Faculty of Education. Additionally, several interviews were conducted with the students, revealing various issues they face, including a lack of skills in animated video production.

To confirm and support the research problem, the researcher conducted an exploratory study on a sample consisting of 16 students from the professional diploma program (students outside the sample of the pilot study and the main experiment). The aim was to assess the students' ability to produce animated videos. A summary of the survey results can be presented as follows:

1. 87% of the students have the prerequisite requirements necessary to study the online educational content for producing interactive animated videos.
2. 90% of the students have deficiencies in producing interactive animated videos according to quality standards.

Therefore, the current research aims to enhance the academic performance, cognitive aspects, and skills related to producing animated videos through the flipped classroom approach.

Achievement Test:

This test aims to measure the cognitive achievement of diploma students in animated video production. The test assesses (72) behavioral objectives. After presenting the test to the judges to verify its validity and reliability, the number of questions in the test reached (72) questions, distributed as follows: (24) multiple-choice questions with four alternatives, of which only one is correct; (36) true/false questions; and (12) matching questions involving numbers in the image.

To adjust the test, the following steps were followed:

1. Verify the validity of the test; to ensure the validity of the test, the method of content validity (judgment validity) was used by presenting the teSst in its initial form to a group of experts and evaluators specialized in the field of educational technology, a significant majority agreed on the relevance of the questions to the behavioral objectives, the correctness of the language formulation of most test items, and the comprehensiveness of the questions covering all elements of the content.
2. Calculating the reliability of the cognitive test; the reliability of the test was calculated using the test-retest method. This method involves

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calculating the correlation coefficient between the students' scores in the first test and their scores in the second test. The test was administered twice, and then Pearson's correlation coefficient (r) was computed. Finally, the reliability coefficient was calculated using Holsti's formula. By applying the previous formula, it was found that the test items achieved significant correlations with the total test score, as the correlation coefficient was (0.785) at the (0.05) level, indicating that the test exhibits internal consistency.

Performance skill observation card:

The observation card aims to measure the performance aspect of diploma students in the Educational Technology department and assess their proficiency in skills related to animated video production. The card was presented to a group of judges, experts, and specialists in the field of Educational Technology for refinement and to ensure its accuracy. The final version of the card contains (5) main skills and (30) sub-skills, which include (154) performance skills.

Table 2 *Key skills in the performance observation checklist*

NO	Key skills for performance skill observation card
1	The skill of planning for designing animation video.
2	The skill of transforming drawings into cartoons using Adobe Animate CC.
3	The skill of editing elements in video.
4	The skill of final output for animation video.
5	The skill of adding interactivity to animation video.

To adjust the observation card, the following steps were followed:

a. The calculation of apparent validity (validity of the judges); it refers to the overall appearance of the card in terms of the type of skills, how they are formulated, the instructions of the card, its accuracy, the objectivity it embodies, the appropriateness of skill analysis, the correctness of the sequence of skill performance steps, and the accuracy of the linguistic formulation of the card's phrases, to ensure the card's suitability for measuring what it was designed for. To verify this, the card was presented to a group of judges and experts to gather their opinions on the aforementioned aspects and to suggest any modifications they deem necessary. It was considered that achieving an agreement rate of more than (80%) is an indicator of its validity to be included among the skills of the card.

b. The reliability coefficient of the skill performance observation card was calculated by applying it to a pilot sample of (4) students (outside the main research sample). This was done using the inter-rater agreement method to calculate reliability, where more than one observer observes the students' behavior, provided that each observer records their observations independently of the others and that all observers complete their recordings at the same time. The number of agreements among the observers regarding the performance of skills in producing interactive animated videos was determined.

The product evaluation card aims to measure the quality of the design of interactive animated videos and the goals achieved within a specific timeframe. The current study aims to enhance the performance aspect of skills in producing interactive animated videos for professional diploma students in the Educational Technology department, following the completion of content study through an e-learning environment designed in light of the interaction between blended learning styles (flexible/flipped) and cognitive styles (independent/dependent). The evaluation card is formulated as a list consisting of (3) main skills and (22) sub-elements.

To adjust the product evaluation card, the following steps were followed:

a. Calculating the validity of the product evaluation card; the validity was assessed using the content validity method by presenting the card to a group of judges and experts in the field of Educational Technology.

b. The internal consistency of the final product evaluation card was verified by calculating the Cronbach's alpha reliability coefficient on the post-test scores of the product evaluation card, using the Statistical Package for the Social Sciences (SPSS) software for the post-application scores, The results indicated a high reliability coefficient for the final product evaluation card, which demonstrates the accuracy of this card. The average agreement among the observers was (93.5%), which is a high percentage that ensures the reliability of the observation card. If the

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agreement rate is (85%) or higher, this indicates a high level of reliability for the observation card.

Research procedures:

The current research was based on the following procedures:

1. Reviewing the literature and previous research related to the current research topic to benefit from them in preparing the theoretical framework, designing research tools and experimental treatment materials, as well as linking the research findings to the results of previous studies.
2. Analyzing the research sample and informing them about the nature of the research.
3. Selecting the instructional design model for the flipped classroom environment, specifically the model by Abdel Latif Al-Jazzar (2013), due to its suitability for the nature of the current research and working according to its procedures and steps in designing and producing experimental treatments.
4. Selecting the Buzz Group Strategy, which is one of the collaborative and cooperative learning strategies used to conduct educational activities within the flipped classroom environment.
5. Preparing and regulating the research requirements, which are outlined as follows:

a. Defining a list of the objectives to be achieved, which includes the general objectives and the behavioral objectives for each lesson of the training content, and presenting it to a group of experts and specialists in educational technology, with the aim of arriving at the final list of objectives after making adjustments and notes based on the reviewers' feedback.

b. Preparing a list of skills for producing animated videos and presenting it to a group of experts in the field of educational technology.

c. Preparing a list of criteria for designing an online environment using the Moodle Cloud learning management system.

6. Preparing and regulating the research tools, which consist of:

a. An achievement test for the content of animatio video production.

b. A performance observation card for producing animation video.

c. A product evaluation card for animation video.

d. A test of the included forms for classifying students according to their cognitive style as (independent/dependent) on the cognitive field.

7. Designing the flipped classroom environment according to the developed Abdul Latif Al-Jazzar model (2013), which includes the following stages:

a. Designing learning resources from multimedia and others.

b. Preparing a scenario for designing a website for the flipped classroom environment through Moodle Cloud to develop the skills of producing animated videos.

c. Designing and producing the learning website through the learning management system (Moodle Cloud), and creating a (Group) for each of the experimental groups on the WhatsApp application.

d. Presenting the educational website to a group of experts and educational technology professors to determine its suitability for the work, and making the required modifications in light of their opinions to reach the final image.

8. onducting a pilot experiment for the research on a sample of (8) students outside the basic research sample, to ensure the stability of the research tools (achievement test for animation video production skills - performance skill observation card - product evaluation card) to determine the time required to apply the achievement test, and to ensure the stability of the performance skill observation card, and the efficiency of the animation video product evaluation card, in addition to identifying the difficulties that the researcher may face while applying the basic experiment for the research and trying to overcome them.
9. Prepare usernames and passwords for the training site.
10. Apply the basic search experience.
11. Post-test application of research tools (achievement test for interactive animation video production skills – performance skill observation card – product evaluation card).
12. Monitoring students' grades in research tools.
13. Conducting statistical processing of the results, using the statistical program (SPSS V. 23).
14. Presenting, interpreting and discussing the results in light of the theories and studies related to the research variables.

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15. Providing recommendations in light of the findings, and formulating proposals for future research.

Results:

By studying the courses of innovations in education for students of vocational education technology and their study of the skills of producing video effects using an environment based on blended learning (flexible/flipped) which was prepared by students, and what it contains of multimedia elements, students showed good creativity in the research results in the knowledge achievement There is no skill There is a product, and we will do that in response to the following questions where the research problem was solved in the following main question:

What is the effectiveness of an electronic environment based on blended learning models (flexible / flipped) in developing animation video production skills for professional diploma students?

The following sub-questions branch out from the main question:

1. What is the list of animation video production skills that should be acquired by professional diploma students in educational technology?
2. What is the list of design standards for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?
3. What is the proposed instructional design for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?
4. What is the effectiveness of an electronic learning environment based on blended learning models (flexible/flipped) in developing the cognitive aspect of animation video production skills for professional diploma students?
5. What is the effectiveness of an electronic environment based on blended learning models (flexible/flipped) in developing the performance aspect of animation video production skills for professional diploma students?
6. What is the effectiveness of an electronic environment based on blended learning models (flexible/flipped) on the quality of animation video products created by professional diploma students?

The following research hypotheses have been formulated:

1. There are no statistically significant differences at the level of ≤ (0.05) between the mean ranks of the scores of the two experimental groups in the post-test for the cognitive assessment of animation video production skills among professional diploma students.
2. here are no statistically significant differences at the level of ≤ (0.05) between the mean ranks of the scores of the two experimental groups in the post-test of the performance observation checklist for animation video production skills among professional diploma students.
3. There are no statistically significant differences at the level of ≤ (0.05) between the mean ranks of the scores of the two experimental groups in the post-test of the evaluation card for the animated video product among diploma students.

To answer the previous research questions and verify the validity of its hypotheses, the researcher used the Mann-Whitney U Test for two independent samples to compare the mean ranks of performance scores in the cognitive achievement test for the two experimental groups, as well as the mean ranks of performance scores in the skills of producing animated videos, and the mean ranks of the quality of the animated video product among diploma students (post-test), using the statistical package for the SPSS program version (23).

The answers to the research questions can be presented in detail as follows:

The first question: What is the list of animation video production skills that should be acquired by professional diploma students in educational technology?

The list of animation video skills for professional diploma dtudents was developed after reviewing studies and research related to the topic, as well as examining the courses addressing animation video production. A preliminary list of skills was identified, which included five main and (30) sub-skills, which include (154) performance skills. The performance skill observation card was administered in both pre-test and post-test formats.

The second question: What is the list of design standards for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?

After reviewing studies and research and utilizing a set of educational literature in the fields of e-learning and educational technology, as well as blended learning a set of criteria was developed for designing an e-learning

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environment based on blended learning models (flexible/inverted). The initial list included seven criteria, each containing a set of related indicators, totaling 175 indicators. After review, the final list of criteria was refined to include seven criteria, with each criterion containing a set of related indicators, totaling 168 indicators.

The third question: What is the proposed instructional design for an electronic learning environment based on blended learning models (flexible/flipped) to develop animation video production skills for professional diploma students?

The current research focuses on designing and building blended learning environments (flexible/ flipped). Therefore, several instructional design models were reviewed in general and blended learning design models in particular, which have been adopted by many researchers in designing blended learning environments (flexible/ flipped), such as the model by Amal Al-Mouzan (2020), the model by Al-Qahtani and Al-Bishi (2017), the model by Amal Hamid (2016), Hack's model (2016), Al-Dosuki's model (2014), Al-Fuqai's model (2011), Picciano's model (2009), Al-Bitar's model (2005), Huang and Zhou's model (2005), and the D.P Office for Domestic Preparedness model (2003). The developed instructional design model by Abdul Latif Al-Jazzar (2013) was then selected. This model aims to help researchers and students develop lessons and learning units as an integrated educational system. The model consists of five stages: Analysis, Design, Production and Construction, Evaluation, and Use. The reasons for choosing Abdul Latif Al-Jazzar's model (2013) are as follows:

1. It is based on the general instructional design model ADDIE, which is influenced by modern trends and developments in designing educational resources.
2. The model is contemporary and suitable for the nature of the study.
3. It is applicable at all levels, from a lesson or unit to an entire course, due to the flexibility of the model.
4. It is suitable for developing the educational system (training programs) in the educational field.
5. It aligns with the methodology and steps of systems thinking.
6. It is based on constructivist and social constructivist theories, making it compatible with the design of blended learning environments (flexible/inverted) based on those theories.
7. Its steps are comprehensive of all instructional design and development processes, with clarity and logical progression.
8. It is simple and straightforward, making it suitable for applying various educational strategies.
9. It organizes the sub-steps for each of the five model stages.
10. This model has proven effective in designing blended learning environments, as many studies have used it for designing blended learning environments, such as the study by Hussein (2022).

The fourth question: What is the effectiveness of an electronic learning environment based on blended learning models (flexible/flipped) in developing the cognitive aspect of animation video production skills for professional diploma students?

To answer the fourth question, the researcher followed these procedures: The validity of the hypothesis related to the cognitive achievement aspect of animation video production skills was tested and confirmed using the SPSS statistical software package. To address the fourth question, the first hypothesis of the research was formulated, which states that there are no statistically significant differences at the level of ≤ (0.05) between the mean scores of the two experimental groups in the post-application of the cognitive achievement test for animation video production skills among diploma students.

A non-parametric statistical method represented by the Mann-Whitney U Test was used for two independent samples on the cognitive achievement test of animation video production skills among diploma students, as shown in Table (1).

Table (1)

The significance of the differences between the mean ranks of the two experimental groups for the post-test on the cognitive achievement test of animation video production skills among diploma students.

Test	Groups	N	Average Rank	Average total ranks
The post-test application of the achievement test.	Flexible blended learning	10	5.5	55
	Flipped blended learning	10	15.5	155

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Table (2)*The significance of the differences between the mean ranks of the two experimental groups for the post-test on the cognitive achievement test of animation video production skills among diploma students.*

Test	Post application	Value	Statistical significance
Cognitive Achievement Test for Animation Video Production Skills	Mann-Whitney U	0.000	0.000
	Wilcoxon W	55	
	z	3.785	
	Asymp. Sig. (2-tailed)	0.000	
	Exact Sig. [2*(1-tailed Sig.)]	0.000	

It is evident from Table (2) that the calculated Z value for the cognitive achievement test for animation video production skills is (3.785), which is greater than the critical value, indicating statistically significant differences at the significance level of (0.01) between the mean ranks of the two experimental groups in favor of the second experimental group with the flipped blended learning model after the application of the electronic learning environment based on the two blended learning models in developing animation video production skills among professional diploma students. This means that the cognitive aspect of the students in the second experimental group with the flipped blended learning model improved more than that of the first experimental group with the flexible blended learning model. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, which states: There are statistically significant differences at the level of (≤ 0.05) between the mean ranks of the scores of the two experimental research groups in the post-application of the cognitive achievement test for animation video production skills among professional diploma students in favor of the second experimental group.

To calculate the effect size, the researcher used the Eta-squared "η2" measure to determine the effect size of the independent variable, which is the use of the blended learning environment (flexible/flipped), on the dependent variable, which is the development of the cognitive aspect of animation video production skills.

Using statistical methods to calculate the Eta-squared (η2) value, the results are presented as shown in Table (3):

Table (3) *The effect of the electronic environment for blended learning in its flexible and flipped forms on the cognitive achievement test of animation video production skills*

Test	Cognitive Achievement Test for Animation Video Production Skills
Z value	3.785
Eta-squared "η2"	0.77
Effect value	High

By observing the value of Eta squared (η^2), it is evident that the effect size of the blended learning environment in developing animated video production skills was significant in the cognitive achievement test, with a value of (0.77). This is because the η^2 value is greater than (0.14). This result indicates that 77% of the total variance in the dependent variable (cognitive achievement in animated video production skills) is attributed to the independent variable (the electronic environment for blended learning in developing animation video production skills).

From Tables (2) and (3), it is clear that (Z) value is statistically significant, and the effect size of the independent variable (the electronic environment for blended learning in its flexible and flipped modes) is substantial on the dependent variable (cognitive achievement in animated video production skills). This indicates the effectiveness of using the electronic environment for blended learning in developing animation video production skills.

The fifth question: What is the effectiveness of an electronic environment based on the two models of blended learning (flexible/flipped) in developing the performance aspect of animation video production skills among professional diploma students?

To answer the fifth question, The validity of the hypothesis related to the performance aspect of animation video production skills was tested and verified using the Statistical Package for Social Sciences (SPSS), which states that there are no statistically significant differences at the level of ≤ (0.05) between the average scores of the two experimental research groups in the post-application of the performance observation card for animation video production skills among professional diploma students.

The researcher used a non-parametric statistical method represented in Mann-Whitney- U test on the skill performance observation checklist for animation video production skills among professional diploma students.

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Table (4)*Significance of the differences between the average ranks of the scores of the two experimental groups for the post-measurement on the performance observation card for the skills of producing animated video skills among professional diploma students.*

Test	Groups	Number	Average rank	Average total ranks
Post-application of the performance observation card for animation video production skills	Flexible blended learning	10	5.5	55
	Flipped blended learning	10	15.5	155

Table (5)*Significance of the differences between the average ranks of the scores of the two experimental groups for the post-measurement on the performance observation card for the skills of producing animated video skills among professional diploma students.*

Test	Post application	Value	Statistical significance
Cognitive Achievement Test for Animation Video Production Skills	Mann-Whitney U	0.000	0.000
	Wilcoxon W	55	
	Z	3.780	
	Asymp. Sig. (2-tailed)	0.000	
	Exact Sig. [2*(1-tailed Sig.)]	0.000	

It is clear from Table (5) that the calculated Z value for the performance observation card for animation video production skills is equal to (3.780) which is greater than the threshold value, indicating that there are statistically significant differences at a significance level of (0.01) between the average ranks of the two experimental groups in favor of the second experimental group, the flipped blended learning style, after applying the e-learning environment based on the two blended learning styles in developing animation video production skills among vocational diploma students, which means that the performance aspect of animation video production skills improved among students of the second experimental group with the flipped blended learning style to a greater extent than the first experimental group with the flexible blended learning style. Thus, the null hypothesis is rejected and the alternative hypothesis is accepted, which states that: There are statistically significant differences at a level of ≤ (0.05) between the average ranks of the two experimental research groups in the post-application of the performance observation card for animation video production skills among vocational diploma students in favor of the second experimental group.

To calculate the effect size: The researcher used the Eta square measure "η2" to determine the effect size of the independent variable, which is: the use of the blended learning environment (flexible/flipped), on the dependent variable, which is: the development of the performance and skill aspect of the animation video production skills.

Using statistical methods to calculate the value of eta square "η2" the results came as shown in the following table (6):

Table (6)*The size of the electronic environment for blended learning in its flexible and flipped forms on the performance observation card for the skills of producing animated video*

Test	Cognitive Achievement Test for Animation Video Production Skills
Z value	3.780
Eta-squared "η2"	0.862
Effect value	High

By observing the value of the Eta square "η2", it becomes clear that the size of the effect of the blended learning environment in developing the skills of producing animated video was large in the observation card, as its value was (0.862), because the value of "η2" is greater than (0.14), and this result means that 86% of the total variance of the dependent variable (skill performance of the skills of producing animation video) is due to the independent variable (the electronic environment for blended learning in developing the skills of producing animated video).

From Tables No. (5) and (6), it is clear that the value of (Z) is statistically significant, and the size of the effect of the independent variable (the electronic environment for blended learning in its flexible and flipped forms) is large on the dependent variable (the skill performance of animation video production skills), and this indicates the effectiveness of using the electronic environment for blended learning in developing animation video production skills.

The Sixth question Question: What is the effectiveness of an electronic environment based on the two models of

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blended learning (flexible/flipped) on the quality of the animatio video product for professional diploma students?

To answer the fifth question, The third hypothesis was formulated, which states that there are no statistically significant differences at the level of ≤(0.05) between the average ranks of the scores of the two experimental research groups in the post-application of the animation video product evaluation card for professional diploma students. To test the validity of this hypothesis, the researcher calculated the average ranks of the post-measurement scores of the product evaluation card for professional diploma students.

The researcher used a non-parametric statistical method represented in Mann-Whitney- U test on the skill performance observation checklist for animation video production skills among professional diploma students.

Table (7) *Significance of the differences between the average ranks of the scores of the two experimental groups for the post-measurement on the animation video product evaluation card for professional diploma students*

Test	Groups	Number	Average rank	Average total ranks
Post-application of the Animation Video Product Evaluation Card	Flexible blended learning	10	5.55	55.5
	Flipped blended learning	10	14.45	154.5

Table (8) *Significance of the differences between the average ranks of the scores of the two experimental groups for the post-measurement on the animation video product evaluation card for professional diploma students*

Test	Post application	Value	Statistical significance
Cognitive Achievement Test for Animation Video Production Skills	Mann-Whitney U	0.500	0.000
	Wilcoxon W	55.500	
	Z	3.750	
	Asymp. Sig. (2-tailed)	0.000	
	Exact Sig. [2*(1-tailed Sig.)]	0.000	

It is clear from Table (8) that the calculated Z value for the animation video product evaluation card is equal to (3.750) and is greater than the threshold value, which indicates that there are statistically significant differences at a significance level of (0.01) between the average ranks of the two experimental groups in favor of the second experimental group, the flipped blended learning style, after applying the e-learning environment based on the two blended learning styles in developing the quality of the animation video product among vocational diploma students, which means that the performance aspect of the quality of animation video production improved among students of the second experimental group with the flipped blended learning style to a greater extent than the first experimental group with the flexible blended learning style. Thus, the null hypothesis is rejected and the alternative hypothesis is accepted, which states that: There are statistically significant differences at a level of ≤ (0.05) between the average ranks of the scores of the two experimental research groups in the post-application of the animation video product evaluation card among vocational diploma students in favor of the second experimental group.

Using statistical methods to calculate the value of eta square "η2", the results came as shown in the following table (9):

Table (9)*The effect size of the electronic environment for blended learning in its flexible and flipped forms on the quality of the animation video product*

Test	Cognitive Achievement Test for Animation Video Production Skills
Z value	3.750
Eta-squared "η2"	0.698
Effect value	High

By observing the value of Eta square "η2", it becomes clear that the size of the impact of the blended learning environment on developing the quality of the animated video product was large in the evaluation card of the animated video product, as its value was (0.698) because the value of "η2" is greater than (0.14), and this result means that 69% of the total variance of the dependent variable (the quality of the animated video product) is due to the independent variable (the electronic environment for blended learning in its flexible and flipped forms).

From Tables No. (8) and (9), it is clear that the value of (Z) is statistically significant, and the size of the impact of the independent variable (the electronic environment for blended learning in its flexible and flipped forms) is large on the dependent variable (the quality of the animated video product), and this indicates the effectiveness of using the electronic environment for blended learning in developing the skills of producing animation video.

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Summary of results:

There is a statistically significant difference between the average ranks of the scores of the cognitive achievement test for animation video production skills among professional diploma students in favor of the second experimental group, and that the use of the electronic environment based on the two styles of blended learning (flexible/flipped) had a significant impact on the cognitive aspect of animation video production skills, as the value of Eta square "η2" was equal to (0.77), which is greater than (0.14).

There are statistically significant differences at the level of ≤ (0.05) between the average ranks of the scores of the two experimental research groups in the post-application of the performance observation card for the skills of producing animated video skills among professional diploma students in favor of the second experimental group, and that the size of the impact of the electronic environment based on the two styles of blended learning (flexible/flipped) was large in the skills of producing animated video, as the value of the Eta square "η2" was equal to (0.86), which is greater than (0.14).

There are statistically significant differences at the level of ≤ (0.05) between the average ranks of the scores of the two experimental research groups in the post-application of the animation video product evaluation card for professional diploma students in favor of the second experimental group, and the size of the impact of the electronic environment based on the two styles of blended learning (flexible/flipped) was large in the quality of the animation video product, as the value of the Eta square "η2" was equal to (0.69), which is greater than (0.14).

Recommendations:

The necessity of following standards in designing e-learning environments based on the two models of blended learning (flexible/flipped).

Directing the attention of educators and specialists to increase interest in e-learning environments based on blended learning patterns (flexible/flipped) due to their important role in enriching their experiences and skills.

Utilizing the e-learning environment to present knowledge and skills aimed at developing learners' understanding and abilities, enhancing their comprehension of scientific concepts, and improving their proficiency in skills related to producing animation video content and ensuring the quality of the final product.

Utilizing the findings of the current research at the applied level to develop and design e-learning environments based on blended learning models (flexible/flipped) to enhance cognitive achievement and skill performance in animatio video production and product quality among postgraduate students.

Ethical Approval Declaration

"All procedures involving human participants in this study were conducted in accordance with the ethical standards set by applicable research guidelines and the principles of the 1964 Declaration of Helsinki and its subsequent amendments. Ethical approval was secured before the commencement of data collection."

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Data availability:-

The datasets generated and analysed during the current study will be available from the author upon reasonable request.

Consent for publication:-

I hereby provide consent for the publication of the manuscript detailed above.

Competing interests:-

The authors declare no competing interests

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