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Integrating Pedagogical Intelligent Agent and Content Display Patterns in Virtual Learning Environments for Promoting the Skills of Digital Learning Objects Production

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Abstract
The current research aims to develop the performance and cognitive aspect of digital learning object production skills of postgraduate students specializing in educational technology using (Articulate Storyline3) program, by designing a virtual learning environment based on the interaction between multiple intelligent agent patterns (dynamic/interactive) and content display patterns (full/ partial). To achieve the research objectives, the experimental approach was followed and the research sample was divided into (94) male and female students from graduate students majoring in educational technology at the Faculty of Education, Tanta University for the academic year 2023/2024. With a quasi-experimental design consisting of (4) experimental groups, at a rate of (22) students per group, the research tools were an achievement test, an observation card for the skills of producing digital learning objects, and a final product evaluation card, taking into account the standards of designing the virtual environment and producing digital learning objects and pedagogical intelligent agent's two forms. After using the appropriate statistical methods, the research results reached the effectiveness of the proposed treatment, which is the virtual learning environment based on the interaction between the two forms of the intelligent agent and the two forms of displaying the content, in developing the skills of producing digital learning objects among graduate students majoring in educational technology. The post-measurements were in favor of the intelligent agent (interactive) group and the (partial) content display pattern. The research recommended employing the intelligent interactive agent technology in electronic learning environments for its ability to enrich the educational experience, direct learners' activity within those environments, and provide supportive feedback for learners' performance.

Keywords: *virtual learning environment- multiple pedagogical intelligent agent- sequential display of content- digital learning object*

Introduction

Recently, a tremendous development in educational practices has emerged in terms of the development of the diverse electronic educational environments. Because of the call for building a digital citizen and a student who can keep pace with technological challenges, there has become an urgent need for a digital teacher capable of using technology and able to use scientific content and tools for explanation and empowerment. Consequently, the task of both the student, the teacher, and even the officials and guardians has become difficult. That is, it requires analyzing educational practices to opt for the appropriate content and patterns for learners. These classroom technological practices include collaborative and blended e-learning, flipped learning, augmented reality, as well as mobile learning, virtual environments, and artificial intelligence.

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Nowadays, the cognitive advancement has led to the flow of huge amounts of information that resulted from global innovations, and it has become difficult to control them in terms of quality or quantity. This development has appeared specifically in educational aspects. For example, technological innovations have become an integral part of the educational situation, especially after the spread of the COVID-19 pandemic and the adoption of precautionary measures, which include human distancing. The typical solution to this crisis was distance learning using technological innovations and developments such as educational platforms, intelligent learning environments, and audio and video communication programs. Over the past decade, technological developments have greatly affected educational systems, revealed new attractive methods for students, and provided more effective educational processes. Virtual reality is an innovative educational technology with great educational potential. According to Allison et al. (2012), it has been an emerging technology in the educational scene, especially educational platforms that rely on virtual reality with their ability to provide students and teachers with a wide range of training procedures in many difficult fields. In educational systems, virtual reality environments can provide great assistance for teachers in their teaching processes. Most importantly, such environments are useful for students in their acquisition and understanding of knowledge. Moreover, virtual reality, according to Grivokostopoulou, Perikos & Hatzilygeroudis (2016), enhances the learning experience for students as well as the effectiveness, attractiveness, and impact of learning.

Virtual learning environments have many unique characteristics and potentials (Khaled Noufal, 2010; Walid Al-Halfawi, 2011; Amani Awad, 2018). These virtual environments are characterized by the ability to display experiences in an embodied manner through the redisplay of three-dimensional reality. They increase the learner's sense of realism of the educational situation, and allows interaction and participation between learners, which helps in solving real learning problems, proposing appropriate solutions, and increasing the sense of involvement resulting from embodiment in the form of a virtual object for each learner. In addition, it encourages learners to question scientific and realistic facts, and helps them interact with others and with virtual objects within this environment through the Internet.

Abdul Aziz Talaba (2010) indicates that the inappropriate content display limits the educational outcome of a specific learning strategy regardless of controlling the rest of the variables of this strategy. Muhammad Abdul Hamid (2013) highlights that scholars have to focus on designing the variables of display and content in e-learning software for its impact on the multiple learning outcomes.

Therefore, the content in virtual learning environments is designed to contain interactive activities that require the learner to respond to some questions or exercises. Then the learner's response is sent, and the program provides him with appropriate feedback, or it may direct the learner to explore some sites related to the content, such as exploratory activities that allow the learner to build materials that suit his needs and help increase his motivation towards learning. Simultaneously, the learner needs navigational guidance within these environments (Khalida Abdel Rahman, 2008).

Unlike traditional educational systems that support shyness, fear and dependence on the learning process, the organization of the sequence of content display within electronic learning environments are crystallized as a means of electronic learning based on the activity of learners and their control over the process of interacting with the content and interaction interfaces. In addition, they support the quality and magnitude of the content and enables the learner to explore and delve into the educational material according to his needs, ability, mental capacity, and self-step (Yavuz, 2008).

In the context of organizing the display of content within virtual environments, many strategies have emerged to present educational content, including the (total/partial) content display method based on the content display theory and the expansion theory. The theories support the total content display method based on the vertical approach, as it depends on presenting all topics in educational modules. Later, the student has the right to choose the module with which to start. Therefore, when using this method, it is necessary to ensure that the modules do not depend on each other in the educational curriculum. Conversely, in the partial content display method based on the horizontal approach, the content parts or modules are displayed in a successive series to prevent the student from bypassing the modules, especially if they depend on each other or are linked in a way that may lead to a deficiency in the learner's information or skills if they bypass the order of content display (Buch et al., 2018; Qiang, 2016; Cai et al., 2014). For better and more effective organization for the teacher and learner within electronic learning environments, artificial intelligence applications have provided more support and organization within these environments. Artificial intelligence in virtual and intelligent learning

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environments is an indispensable necessity, namely the date intelligent educational agent.

Krupansky (2010) defines the pedagogical intelligent agent as a computer program that works to achieve specific dynamic goals (in which the change is natural) on behalf of other entities (computer or human) over an extended period and without direct supervision or control. It also shows a high degree of flexibility and creativity in the way it seeks to transform goals into educational tasks. There are also two basic patterns for presenting the intelligent agent in electronic learning environments: the single agent and the multi-intelligent agent. Each of these two patterns has theoretical support (Zainab Al-Arabi, 2014). Abdel Hamid Bassiouni (2005) expounded that the single-agent environment, on the one hand, includes one agent that affects the environment, such as a diagnostic program. On the other hand, the multi-agent environment includes more than one agent, such as in most collaborative and competitive games.

Kiourt et al. (2017) indicated that the multi-intelligent agent can be employed within the e-learning environment in more than one form. It is seen as a group of intelligent programs that appear in the form of cartoon characters that differ in their design (static/moving/interactive). This leads to a difference in the design of the multi-intelligent agent characters, which leads to an increase in motivation towards learning because of the diversity of visual stimuli. It also varies in the form of presenting information, from simplicity in design in the form of a static image to moving characters that can move within the educational screen, and develops to the interactive style that can provide voice commentary, visual expression, and give various expressions and reactions.

In the light of the above-mentioned surveyed literature, the need arises to identify which of the two types of multiple intelligent agents (moving/interactive) is compatible with the patterns of content display sequence (full/partial) that most improve learning. Hence, developers and designers of these environments can use it. In the same vein, the intelligent educational agent, according to Richter (2006), can develop learning strategies based on interaction through neural networks and genetic algorithms.

According to Wenger (2019) and Themis, Stassic & Poulos (2016), the intelligent agent facilitates the processes of navigation, knowledge extraction and problem-solving among learners. It is also an approach to interactive learning as it helps in presenting, organizing, and selecting learning materials according to the characteristics of the learner. It also helps in providing appropriate reinforcement at the appropriate time and answering learners' inquiries, which improves performance and achieves learning goals. It can also be employed within the learning environment so that it works as a guide and assistant to the learner and guides him to solve his academic problems.

The pedagogical intelligent agent highlights several possibilities in intelligent learning environments, such as navigational guidance that learners are guided around a complex virtual environment and prevented from getting lost. Also, it helps gaze and gesture as a guide: agents can point to and look at objects in the environment to attract the learner's attention. Moreover, they provide non-verbal feedback; agents with dynamic characters can provide verbal and non-verbal feedback. These non-verbal signals can take different forms, such as nodding, shaking the head, or facial expressions such as smiling or feeling surprised, conveying, and eliciting emotion. Dynamic agents can express emotions and motivate learners. Agents also represent companions to learners within virtual environments, through role-playing within the learner team. Finally, it can function as adaptive pedagogical interaction: through the dynamic nature of the face, the interaction between the agent and the learner is a necessity that makes learning highly adaptive. In turn, agents can respond to interruptions, take turns, and the various actions that the learner may take during instruction (Johnson & C. Lester, 2016).

Linquin et al. (2017) and Luo & Leite (2018) state that several theories have supported the multi-intelligent agent, including the theory of distributed cognition, the theory of social and cultural learning, and the extraneous cognitive load. The main gist of these theories is that the intelligent agent plays the role of the teacher in explaining the educational material. According to the social theory, the degree of interaction varies according to the design pattern of the intelligent agent's personality. In addition, the theory of cognitive load states that the agent's personalities are multiple and their use of multimedia and different responses works to reduce the cognitive burden on the learners' memory to absorb and retain information easily.

Employing technological applications and digital learning resources to understand and analyze natural and human phenomena, track relationships, make comparisons, monitor contemporary problems, identify their causes and ways to solve them scientifically contribute significantly to achieving the goals and improving the quality of the educational process. Digital learning objects are one of the most significant digital learning resources employed in

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teaching any subject or educational content (Hanan Abdel Salam, 2020).

Digital learning objects are known as the smallest digital part of the content and can be reused in different educational situations in the form of educational objectives, activities, text, audio, fixed and moving movements, or a test and may be combined to form an educational lesson (Ahmed Abdel Majeed, 2014). Digital learning objects contribute to developing the educational process through many advantages. That is, they employ technology effectively, which works to create new resources for effective learning. Also, they are characterized by the availability of educational content at any time and place and facilitate access to them. Moreover, they encourage interactivity and tailor learning experiences for learners, thus saving time, effort and cost (Nash, 2005). The significance of digital learning objects is highlighted by the possibility of sharing them and their multiple uses in more than one educational environment, which reduces the challenges facing those in charge of teaching in the interactive use of technology. They are also characterized by the possibility of reuse, speed of production, ease of updating, and low costs (Ahmed Salem, 2009). Therefore, it is very necessary to train teachers on using digital learning objects to support and enrich educational curricula to provide more interactivity on curricula and within e-learning environments (Ahmed Badr, 2014; Muhammad Salem et al., 2018; Alfat Al-Harbi, 2020).

Research problem

Through field study and reviewing literature, the researcher noticed the low level of graduate students in terms of designing and producing digital learning objects in accordance with the quality standards and their lack of competencies in employing digital learning objects. In effect, the low competence among graduate students weakens technological and teaching self-efficacy for educational and communication technology courses (Yasser Al-Sayed, 2019). Moreover, the increasing demand for virtual education and virtual reality educational environments as an approach to developing skills among educational technology students seems a must to enable them to master their educational and pedagogical tasks (Al-Shahat Othman et al., 2017).

Hence, the problem of the research lies in the need to identify the most appropriate multiple intelligent agent patterns (dynamic/ interactive) in virtual learning environments and their relationship to content display patterns (full/partial) in order to develop the skills of producing digital learning objects among graduate students specialized in educational technology. Accordingly, it is noted that graduate students specializing in educational technology at the Faculty of Education need to develop skills in producing digital learning objects in light of their job tasks. Therefore, the current research sought to design a virtual learning environment based on interaction between multiple intelligent agent patterns (dynamic/ interactive) and content display patterns (full/partial) to measure their effectiveness in developing skills of producing digital learning objects among graduate students specializing in educational technology.

Study Questions

The current research main question is crystalized as follows:

"How can multiple pedagogical intelligent agent patterns (dynamic/interactive) and content display (full/partial) be employed in a virtual learning environment to develop the skills of producing digital learning objects for graduate students?"

The main question is divided into the following sub-questions:

1- Are there statistically significant differences between the average scores of the research group students in the pre- and post-measurements of the cognitive test of digital learning object production skills among graduate students?

2- Are there statistically significant differences between the average scores of the research group students in the pre- and post-measurements of the cognitive test of digital learning object production skills according to the groups (full interactive/ partial interactive/ full dynamic/ partial dynamic) among graduate students?

3- To what extent do the variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of content (full/partial) and the interaction between them affect the scores of graduate students in the achievement test of digital learning objects production skills?

4- Is there statistically significant difference between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects among graduate students?

5- Is there statistically significant difference between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects according to the groups (full interactive / partial interactive / full dynamic/ partial dynamic) among graduate students?

6- To what extent do the variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of

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content (full/partial) and the interaction between them affect the scores of graduate students in the observation card (performance aspect) of the skills of producing digital learning objects among graduate students?

Hypotheses

Study Hypotheses:

1- There is a statistically significant difference at (≤0.05) between the average scores of the research group students in the pre- and post-measurements of the cognitive test of digital learning object production skills among graduate students.

2- There is a statistically significant difference at (≤0.05) between the average scores of the research group students in the pre- and post-measurements of the cognitive test of digital learning object production skills according to the groups (full interactive / partial interactive / full dynamic/ partial dynamic) among graduate students.

3- The variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of content (full/partial) and the interaction between them affect the scores of graduate students in the achievement test of digital learning objects production skills.

4- There is a statistically significant difference at (≤0.05) between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects among graduate students.

5- There is a statistically significant difference at (≤0.05) between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects according to the groups (full interactive / partial interactive / full dynamic/ partial dynamic) among graduate students.

6- The variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of content (full/partial) and the interaction between them affect the scores of graduate students in the observation card (performance aspect) of the skills of producing digital learning objects among graduate students.

Definition of terms

Agent: Ericsson (1997) highlights the dual meaning of the word "agent". The first meaning emphasizes the presence of certain functional capabilities, like the independent or semi-autonomous use in computer programs. An agent is a non-direct human-controlled program that can initiate actions, forming its own goals, constructing action plans, communicating with other agents, and responding appropriately to events. The second meaning emphasizes the semi-human quality, whereby an agent is used to support programs that appear to have the characteristics of a living being, often a human.

Intelligent agent:

Veletsianos, Russell & Mayer (2014) define intelligent agent as "a virtual entity or character that is controlled by computer programs in virtual learning environments to function various educational goals." The primary goal of using educational agents is to simulate the real-life social educational contexts. Procedurally, the researcher defines the intelligent agent as "a virtual cartoon entity that exists within the virtual environment, which can play the role of a teacher in the virtual learning environments in terms of support and guidance, voice commentary, problem solving, or sharing activities within the virtual environment.

Content display patterns:

Morrison et al., (2011) defines it as the effective use of content that helps the learner achieve the course objectives. Richey, Klein, & Tracey (2011) defines content display as the primary interest of instructional designers and is one of the six areas of the knowledge base for instructional designers. Additionally, Reigeluth (2007) states that content display is making sequence decisions on how to arrange and organize content, as the importance of content display stems from the relationship between course topics and the size of the educational course.

The current research aims to employ the display of the course content in the virtual learning environment for research in a specific sequence in two patterns: (1) full content display pattern in which the entire content is presented so that it is available to the student, and (2) partial content display pattern, in which the content is divided into stages, in each stage a part is studied followed by a mini-test. The student cannot move to the next stage until the current stage is completed.

Digital learning objects:

Magdy Aql (2014) defines digital learning objects as "independent digital units/elements consisting of several integrated educational assets with meaning, and take different forms (texts, sounds, images, drawings, videos), and include the learning entity: goals, content, teaching/learning activities and assessment. They are composed, stored, indexed, communicated and assessed, and distributed via the web, and accessed through their metadata." They can be used and reused in multiple educational contexts according to the different educational needs and individual readiness of learners. A learning

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object takes less than a minute to (15) minutes to display in the educational situation.

Procedurally, the researcher defines digital learning objects as independent, self-contained units, each one has a specific use and purpose, and may vary between texts, images, video clips or audio recordings. The current research will focus on designing an educational unit by employing images, texts and video clips with the program (Articulate Storyline3) to produce digital learning objects.

Study Objectives

The current research aims to:

1. determine the criteria for producing a multi-pedagogical intelligent agent (dynamic/interactive) in a virtual learning environment based on a sequence of content display (full/partial) to develop the skills of producing digital learning objects and deep understanding among graduate students.
2. recognize the criteria for displaying content in a virtual learning environment based on employing the patterns of the multi-pedagogical intelligent agent and the sequence of displaying content to develop the skills of producing digital learning objects and deep understanding among graduate students.
3. identify the criteria for designing digital learning objects in a virtual learning environment based on employing the patterns of the multi-intelligent agent and the sequence of displaying content to develop the skills of producing digital learning objects and deep understanding among graduate students.
4- identify the appropriate educational design for a virtual learning environment based on the patterns of the multi-pedagogical intelligent agent (dynamic/interactive) and the sequence of displaying content (full/partial) to develop the skills of producing digital learning objects and deep understanding among graduate students.
5. investigate the effectiveness of employing multiple pedagogical intelligent agent patterns (dynamic/interactive) and content display sequence (full/partial) in a virtual learning environment to develop (the performance and cognitive aspect) of digital learning object production skills among graduate students.
6. explore the effect of multiple pedagogical intelligent agent patterns (dynamic) and content display (partial) in a virtual learning environment to develop digital learning object production skills among graduate students.
7- explore the effect of multiple pedagogical intelligent agent patterns (dynamic) and content display sequence (full) in a virtual learning environment to develop digital learning object production skills among graduate students.
8- explore the effect of the multiple pedagogical intelligent agent pattern (interactive) and the content display sequence (partial) in a virtual learning environment to develop the skills of producing digital learning objects among graduate students.
9- explore the effect of the multiple pedagogical intelligent agent pattern (interactive) and the content display sequence (full) in a virtual learning environment to develop the skills of producing digital learning objects among graduate students.

Study Methodology:

The current research belongs to developmental research, including the following:

1- The descriptive analytical approach, by reviewing the literature that addressed these skills, as well as discussing the hypotheses and interpreting the results. It is used to prepare a list of criteria for designing a virtual learning environment based on intelligent agent.
2- Developing educational systems` approach in the design and development stage.
3- The quasi-experimental approach used in implementing the treatment in the evaluation stage, to identify the effectiveness of employing intelligent agent patterns and sequencing the presentation of content in a virtual learning environment to develop the skills of producing digital learning objects among graduate students (General Diploma in Educational Technology). The current research follows the 2×2 factorial design as a result of the presence of two independent variables to recognize the effect of the interaction.

Sample:

The current research comprises a sample of postgraduate students (general diploma), numbering (80) students majoring in educational technology at the Faculty of Education, Tanta University, in the academic year (2023/2024).

Study <u>Instruments</u>

First: Tools of data collection:

¬ A questionnaire of training needs for postgraduate students majoring in educational technology (prepared by the researcher).

¬ List of skills for producing digital learning objects using the proposed design (prepared by the researcher).

¬ List of criteria for producing digital learning objects (images, video clips, and audio recordings) (prepared by the researcher).

¬ List of criteria for designing content in the virtual learning environment (prepared by the researcher).

¬ List of criteria for designing the intelligent agent in the virtual learning environment (prepared by the researcher).

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Second: Processing materials and tools: Designing the proposed scenario for a virtual learning environment based on employing intelligent agent patterns (dynamic/interactive) and sequencing the display of content (full/partial) (prepared by the researcher).

Instruments

First: An achievement test to measure the cognitive aspect of the skills of designing and producing digital learning objects (prepared by the researcher).

The achievement test for the cognitive aspect of digital learning object production skills using the (Articulate Storyline3) program was prepared according to the following steps:

- Determining the objective of the test: The objective of the achievement test for the current research is to measure the cognitive aspects of the research sample by conducting a pre-test and a post-test to measure the impact of the treatment of the study.
- Determining the items of the test: The researcher formulated the test items in three types: true or false, multiple choice, and a final question for application. The number of items was (50) items to cover all aspects of the content.
- Preparing the test in its initial form: The achievement test was formulated in its initial form; that the number of test items was (50) items; (26) multiple choice, (23) true or false, and an application question. When correcting the achievement test and preparing the key answer, only one mark is allocated for each item of the test in the case of a correct answer, and (zero) in the case of an incorrect answer.
- Formulating test instructions: The test instructions were formulated clearly and accurately, in addition to a detailed description of the test and how to answer its items in brief phrases.

Validity of the Test:

After analyzing the test items for the purpose of determining their suitability and calculating the coefficients of ease and difficulty, the researcher sought to measure to determine the validity of the test. For this goal, the researcher prepared the specifications table and the initial form was presented to the arbitrators to review the test. Validity of the test was calculated in two ways:

1. Arbitrators: The test was presented to a group of experts and arbitrators specialized in the field of educational technology. According to the arbitrators' opinions, the researcher made the necessary amendments.
2. Calculating the validity of the test by calculating the internal consistency of the test: The test was applied to a sample of (10) students to calculate the correlation coefficients between the score of each question of the test and the total score of the test using Spearman's correlation coefficient. Hence, the correlation coefficients between the score of each question of the test and the total score of the test were between (0.35: 0.92), which are significant coefficients at (0.05), indicating the internal consistency of the test.

- Calculating the test reliability: The test reliability was calculated using the Cronbach's alpha coefficient, by calculating the variance of the questions and the variance of the total score. The reliability coefficient was (0.89), which is a statistically significant correlation coefficient. It indicates the test reliability and its suitability for application.

Second: Observation Card:

- Determining the objective of the observation card: it aimed to measure the performance of the students of the experimental research groups in the skills of producing digital learning objects using the (Articulate Storyline3) program.
- Determining and formulating the items of the observation card in its initial form: The observation card was formulated in light of the list of skills for producing digital learning objects using the (Articulate Storyline3) program summing (9) basic skills and (65) sub-skills, including (284) procedural performance skills.
- Quantitative assessment of the observation card scores: The researcher used the quantitative assessment system for the observation card to measure the performance of the skills in terms of three performance possibilities:

• If the student himself performs the skill well, he obtained two degrees.
• If the student performs the skill and discovered the error himself and corrected it; and obtained one degree.
• If the student does not perform the skill, he obtains zero.

- Then, the instructions of the observation card were formulated clearly and accurately. The card instructions included its purpose, components, use, and how to estimate the grading.

Validity and reliability of the Observation card:

After analyzing the card items for the purpose of determining their suitability and calculating the coefficients of ease and difficulty, the researcher sought to measure to determine its validity. For this goal, the card was reviewed by a group of experts and arbitrators specialized in the field of educational technology. According to the arbitrators' opinions, the researcher made the necessary amendments.

- Calculating the reliability of the observation card: To ensure the reliability of the observation card, the

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observers' agreement method was used, as the researcher sought the help of two other colleagues. They observed (10) students from the exploratory sample of digital learning object production skills using the (Articulate Storyline3) program. In each observation, the number of times of agreement between the observations for each individual was calculated using Cooper's equation. It was found that the lowest percentage of agreement between the observations was (75.51) and the highest percentage of agreement between the observations was (96.67) and the average percentage of agreement between the observations was (87.47). This indicates that the observation card has a high degree of reliability. Also, it is valid for application to the basic experimental sample, as Cooper determined the acceptable level of reliability in terms of the percentage of agreement must be 85% or more to indicate high stability of the tool.

Third: Preparing an evaluation card for the final product:

- Determining the goal of the evaluation card: The card aims to measure the skill aspect of producing digital learning objects through the (Articulate Storyline3) program for the experimental group of the research, by producing an educational activity through the program.
- Determining and formulating the items of the card in its initial form: The researcher prepared a final product evaluation card in light of the list of skills, goals and educational content of the program. The card consisted of (13) main axes, including (48) sub-procedures. The maximum total score of the card is (144) degrees and the minimum score is (48).
- Quantitative assessment of evaluation card items: The quantitative assessment was determined in degrees for each aspect of the skills of producing digital learning objects to evaluate the minimum level of students in the final product so that:

• The student obtains (3) degrees if his performance is good.
• The student obtains (2) degrees if his performance is average.
• The student obtains (1) degree if his performance is poor.

- The card instructions were formulated clearly and accurately to define the purpose of the evaluation card for the arbitrators, and ensure that the content of the evaluation card is read carefully before performing the evaluation process.
- Calculating the reliability of the evaluation card: To ensure the stability of the product evaluation card, the observers' agreement method was used, and the average percentage of agreement between the observations was (93.03), which indicates that the product evaluation card has a high degree of reliability.
- Evaluating the validity of the product evaluation card: The criteria and items of the product evaluation card were formulated in their initial form and then reviewed by the arbitrators in the field of educational technology. Then, the amendments were performed. The researcher also reached an agreement between the arbitrators on the total product evaluation card at a rate of (91.58%), which is a high rate indicating the validity of the card.
- Final image of the evaluation card: After completing the amendments of the evaluation card for the skills of producing digital learning objects, the card in its final form included (13) main axes and (48) sub-criteria. The maximum final score for the product evaluation card was (144) degrees, and the minimum score for the product evaluation card reached (48) degrees.

Study Limitations:

¬ The study is confined within the proposed treatment of designing a virtual learning environment based on the patterns of the multiple pedagogical intelligent agent (Dynamic/ Interactive) and the sequence of displaying content in a virtual learning environment (full/partial).

- The study was performed at Faculty of Education, Tanta University, Department of Curricula and Teaching Methods, Educational Technology specialization.

¬ the study aims at mastering the skills of producing digital learning objects (both performance and cognitive aspects) and deep understanding.

Treatment

The treatment of the research comprised the following steps:

1- Educational design of research materials and tools according to the appropriate educational design model:

By reviewing many educational design models for virtual learning environments to identify the elements of the design of the virtual learning environment for the current research; The model of Muhammad Al-Dasouqi (2015) was chosen to design and develop the virtual learning environment for the current research. The model includes the following stages:

First: measuring the pre-requirements for the teacher:

The researcher (acting as the teacher) measured the input behavior, and determined the competencies that qualify her to apply the virtual learning environment based on the two models of the intelligent agent to develop the skills of producing digital learning objects among graduate students (the subject of the current research).

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Second: Measuring the pre-requirements for graduate students (General Diploma) Specializing in Educational Technology, Faculty of Education, Tanta University:

The research sample included (80) male and female students in the General Diploma Specializing in Educational Technology, Faculty of Education, Tanta University for the academic year (2023/2024). To ensure the success of the current virtual learning environment (treatment), the characteristics of the research sample students must be taken into account, in terms of their mental, psychological, social and cognitive characteristics, computer proficiency, and their ability to navigate within the environment.

Third: Measuring the pre-requirements of the environment:

Due to the application of the research experiment within the Faculty of Education, Tanta University on a sample of graduate students specializing in educational technology at the faculty, the capabilities and obstacles within the faculty were monitored.

(1) Preparation stage: addressing shortcomings in light of the results of the input pre-requirement evaluation stage:

(a) Analysis of learners' experiences: Learners' experiences are analyzed regarding the use of computers.

(b) Determining the requirements that must be available in the virtual learning environment:

In this step, the type of devices required and the presence of an Internet network that allows access to the virtual learning environment are determined. This has already been taken into account, with care being taken to ensure that the students of the research sample have computers and an Internet network in their homes to complete exposure to the content of the research topic.

(c) Determining the technological infrastructure:

In this stage, the infrastructure that must be available in order to implement virtual learning is determined. This infrastructure is represented by the availability of computers and an Internet network for all students of the research sample; as the electronic lab contained (20) computers connected to the Internet and a smart interactive display screen. Although the college provides a (WIFI) network through the (IT) unit in the college, the researcher was keen to provide the Internet to the electronic training lab.

Second: Analysis stage:

This stage included the following procedures:

• Determining the general objectives of the educational content:

In this stage, the educational topics were determined, which are eight topics that deal with the skills of producing digital learning objects using the program (Articulate Storyline3). The topics are explained using the interaction between the two styles of the intelligent agent (dynamic/interactive) and the two styles of content display (full/partial) in the virtual learning environment. The educational objectives were determined and classified according to Bloom's taxonomy, and a specification table was determined for the relative weight of the topics and educational objectives.

• Determining the needs of the learners and their general characteristics:

The researcher analyzed the characteristics of the target group of learners, who are graduate students majoring in educational technology at the Faculty of Education, Tanta University.

• Each student has his own characteristics, ideas, cultural background, and unique experiences.

• Each student has his own learning method.

Therefore, the ages of the research sample vary because the postgraduate stage is not bound by a specific age, which range between 22-40 years. They are characterized by psychological stability, rational thinking, and trying to avoid obstacles, and independence. In general, the cultural, social and economic level of students is close.

The exploratory study:

It comprised a training needs survey form about learners' knowledge of digital learning object production skills and the Articulate Storyline3 program specifically, considering their previous experiences in dealing with computers and the Internet and dealing with virtual learning environments.

Validity of the exploratory study:

In its initial form, the form was reviewed by a group of experts to ensure its validity and express their opinions in terms of accuracy and linguistic correctness. The arbitrators' views were as follows:

• (90%) of the arbitrators agreed that the items measure what they were designed to measure and that the formulation of the items was clear.

• The exploratory study questions were adjusted in terms of formulation and scientific accuracy in light of the arbitrators' suggestions, by making the required amendments, whether by adding, deleting or modifying, to reach the final form.

- Defining educational tasks and activities:

The researcher formulated a variety of activities complementing each topic of the content topics for the

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experimental groups. They were uploaded to the WhatsApp group or through Google classes.

Third: Design phase:

This phase comprised the following procedures:

1/ Defining and formulating procedural objectives for the educational content:

The specific educational objectives for each skill were formulated procedurally in light of the general objective of developing the skills of producing digital learning objects through the program (Articulate Storyline3). Objectives were formulated accurately to describe the expected behavior of students after studying each of the learning skills. The following criteria were considered in terms of objectives:

 Linguistic formulation in clear and specific phrases.

 The objectives should be realistic, observable, and measurable.

 Each objective should include one educational outcome and not a group of outcomes.

 Organizing the objectives and sequencing them from simple to complex.

Accordingly, a list of educational objectives was prepared, including (8) general objectives and (50) procedural objectives for the content of the (Articulate Storyline3) program. They were presented to the arbitrators specializing in educational technology curricula and teaching methods, in order to review them.

2/ Determining and designing the appropriate educational content:

In light of the elements of the learning content, the researcher identified the basic skills necessary to produce digital learning objects using the (Articulate Storyline3) program. The topics within the content were organized in a way that facilitates handling them, as the content was designed and divided into educational modules using the intelligent agent (dynamic/interactive) and two content display modes (full/partial). The reviewers agreed that the content was suitable for application, as (90%) of the arbitrators agreed to apply all the content.

3/ Designing appropriate multimedia:

Textual content: The researcher wrote the textual content (using the environment instructions/environment objectives/list of standards for producing digital learning objects/ways of communicating with the researcher/pre- and post-test) and uploaded it to the environment using HTML.

Educational images: The researcher prepared various images suitable for the educational content by downloading them, attaching them with the content, installing sound, and adding movement and effects to the intelligent agent on the background of the classroom.

Video clips: The researcher used a program to record the computer screen (Camtasia Studio) while explaining the program (Articulate Storyline3) with sound and image in preparation for video editing to add motion graphics to the intelligent agent inside the environment through the program (Adobe After Effect/ Adobe Premiere).

4/ Designing interactive interfaces:

The interactive patterns in the interaction interfaces are represented in the following:

• Clicking on a key or button on the screen of the educational site.

• Choosing from a drop-down list.

• The control buttons should be consistent, fixed and not crowded.

• The learner controls the display sequence and navigates between pages and displays any page he wants to display by clicking on the transition and navigation buttons.

Scenario Design:

The scenario of the virtual learning environment based on the interaction between the two modes of the intelligent agent (dynamic and interactive) and content display patterns (complete/partial) was designed. The elements of the educational scenario for the current research were screen number, screen title, visual aspect and screen layout plan, sound effects, frame sketch, transitions, time, images and drawings, written text. The scenario was presented to the experts in the field of educational technology to express their opinions.

5/ Determining programs and programming languages:

A/ Programs used in content design:

Programs that comply with SCORM standards were used, including:

- Amazing slider program: An easy program to create a query or (Slide Show) for a website or blog (Word Press) or for (Hot Mail) pages of all kinds with ease.

6/ Designing assessment and evaluation tools:

In this step, the researcher designed a list of digital learning object production skills, an achievement test, a note card to measure the performance aspect of digital learning object production skills using the (Articulate Storyline3) program, and a final product evaluation card.

Fourth: Production stage:

- Producing multimedia for the virtual learning environment:

The educational media necessary to produce the virtual learning environment based on the intelligent agent (dynamic and interactive) were identified. Due to the

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nature of the educational content of the educational environment for the current research, the focus was on video clips for the dynamic intelligent agent containing different facial movements and gestures. Additionally, another video for the interactive intelligent agent containing interactive questions that require the student to answer them to complete the video and provide appropriate feedback. The educational media for the learning environment were produced using a set of programs.

 Inclusion of educational content (video clips):

Educational videos were produced for the learning content using the intelligent agent (dynamic and interactive). Then, they were uploaded to the educational environment website

https://yousrastoryline3.ekosysco.com/dashboard/main

In this step, the researcher collected images for the textual content of the educational content. The textual content such as the objectives and instructions for the content were uploaded, as well as the videos for the educational content of the eight modules based on the intelligent agent styles (dynamic/ interactive), and the tests (pre/post achievement test) were uploaded.

/ Production of educational content and activities:

The researcher produced the educational content and activities in their final form based on the general standards and specific design standards. The educational content was inserted into the environment through the control panel of the educational site.

Production of interactive interfaces:

The researcher uploaded the content to the virtual environment. Then, the researcher modified the environment in terms of the style, size of the fonts and colors to be suitable for the learners. The researcher relied on horizontal drop-down lists to facilitate use and navigation within the environment and to access the icons easily.

Recording the data of the students of the research sample in the virtual learning environment:

In this step, the data of the students was recorded in the current virtual learning environment to allow them to learn through the learning environment by creating accounts for each student with a username and password.

Fifth: Evaluation stage:

Testing the virtual learning environment:

After completing the design and production of the environment, it was evaluated before the experiment. The virtual learning environment was evaluated by presenting it to the experts in educational technology to review it.

Sixth: Basic experiment of the research:

The basic experiment for this research went through several stages enduring fourteen weeks, starting from 2/15/2024 to 5/12/2024. The meetings with the students were as follows:

1- Selecting the research sample: The research sample was selected from graduate students with a general diploma specializing in educational technology at the Faculty of Education, Tanta University for the academic year (2023/2024).

2- Introductory session: An introductory session was held with the sample students on Thursday 2/15/2024 to divide them into two groups and clarify the purpose of the learning environment, and the skills.

An organizational session was also held on Thursday 2/22/2024 to distribute the username and password for the environment to the students. In addition, the students joined WhatsApp groups and Google educational classes and uploading the timetable for the experiment.

3- Pre-application of measurement tools: The research tools were pre-applied, namely (the achievement test and the observation card), with the aim of determining the cognitive and skill level of the students on the research topic.

4- Implementation of the experiment: the virtual environment was applied to the four experimental groups, where each group studied using the intelligent agent

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pattern (interactive/dynamic) and content display (full/partial). The researcher also followed up on the students' performance during the experiment to identify the difficulties, respond to their inquiries, evaluate their performance and guide them.

5- Post-measurement tools:

The research tools were applied to assess the skills of producing digital learning objects using the Articulate Storyline3 program. The grades were monitored in preparation for their statistical processing. The students' products of digital learning objects were also evaluated using the product evaluation card.

6- Conducting statistical processing: using students' scores in the achievement test, the observation card, and the final product evaluation, the researcher processed them statistically and extracting the results through the Statistical Package for Social Sciences (SPSS) program, version 27.

Results:

Hypothesis[1]

There is a statistically significant difference at the significance level (≤0.05) between the average scores of the study groups' students in the pre- and post-measurements of the cognitive test of digital learning object production skills among graduate students

To examine the validity of this hypothesis, the **T-Test** for **Paired Sample** was used to recognize the significant differences between the average scores of students in the pre- and post-measurements of the cognitive achievement test of digital learning object production skills in the four experimental groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic). The results are shown in Table (1):

Table (1) T-Test and Cohen's effect size for the differences between the average scores of the study groups in the pre- and post-measurements of the achievement test of digital learning object production skills

Groups	Measurements	No.	Means	Standard deviation	T value	Significance level	(D) For Cohen	Effect size
Full/ interactive	Pre	20	19.05	3,649	21,465	0,000	4,800	high
	Post	20	40.65	3,924				
Partial/ interactive	Pre	20	19.25	2,918	43,453	0,000	9,716	high
	Post	20	46.35	1,387				
Full/ dynamic	Pre	20	21.45	3,818	18,825	0,000	4,209	high
	Post	20	35.70	1,418				
Partial/ dynamic	Pre	20	21.25	5,280	18,272	0,000	4,086	high
	Post	20	38.90	1,483				

****significant at (05,0)**

In light of table (1), the values of the "T" test were (21,465, 43,453, 18,825, 18,272) respectively; statistically significant at (0.05). Such values confirm the statistically significant differences between the average scores of the research sample students in the pre- and post-application of the achievement test of the cognitive aspects of digital learning object production skills, in favor of the post-application. Additionally, it was found that the effect size reached (4,800, 9,716, 4,209, 4,086), respectively, which is a high effect coefficient. This proves the validity of the null hypothesis, and the effectiveness of designing a virtual learning environment based on the interaction between multiple intelligent agent patterns (dynamic/ interactive) and content display pattern (full/ partial) to develop the cognitive aspect of digital learning object production skills among graduate students.

Hypothesis[2]

There is a statistically significant difference at the significance level (≤0.05) between the average scores of the cognitive achievement test for digital learning object production skills according to the groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic) among graduate students.

To examine the validity of the second hypothesis, the means and standard deviations of the scores of the research groups were calculated in the post-test measurements of the cognitive achievement test for post-graduate students majoring in educational technology. The following table illustrates the results:

Table (2) Means and standard deviations of the scores of the research groups in the post-measurements of the cognitive achievement test of digital learning object production skills

Cognitive aspect	The group	number	Mean	Standard deviation
Achievement test	Full/ interactive	20	40.65	3,924
	Partial/ interactive	20	46.35	1,387
	Full/ dynamic	20	35.70	1,418
	Partial/ dynamic	20	38.90	1,483

Table (2) manifests that the values of the means and standard deviations of the scores of the four research groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic) differ statistically in the post-test measurements of the cognitive aspect of the achievement test among post-graduate students majoring in educational

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technology, in favor the partial/ interactive intelligent agent group.

To test this hypothesis, the one-way analysis of variance was employed to reveal the significance of the differences between the average scores of the achievement test for the cognitive aspect of digital learning object production skills according to the groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic) as shown in table (3).

Table (3) One-way analysis of variance for the cognitive test of digital learning object production skills

Cognitive aspect	Source of variance	sum of squares	degrees of freedom	Mean squares	value of "T"	Significance level
Achievement test	Between groups	1196,100	3	398,700	74,068	0,000
	Within groups	409,100	76	5,383		
	Total	1605,200	79			

Table (3) indicates that there are statistically significant differences in the cognitive test of digital learning object production skills between the means of the four research groups, as the value of "F" reached (74.068), which is statistically significant at the significance level (0.01). To reveal the source of these differences, the Scheffe test for multiple comparisons was used, and table (4) shows these results:

Table (4) Scheffe values for the differences between the arithmetic means of the four research groups in the achievement test

Cognitive aspect	The group	mean	Full/ interactive	Partial/ interactive	Full/ dynamic	Partial/ dynamic
Achievement test	Full/ interactive	40.65	-	5,700*	4,950*	1,750*
	Partial/ interactive	46.35		-	10,650*	7,450*
	Full/ dynamic	35.70			-	3,200*
	Partial/ dynamic	38.90				-

*** significant at (0.05)**

In light of table (4), there are statistically significant differences among the four experimental groups and the sources of differences in their arithmetic mean, as it reached (46.35) in the partial/ interactive group; (40.65) in the second place for the full/ interactive group, (38.90) for partial/ dynamic group, and (35.70) in the fourth group for the full/ dynamic group. This confirms the interaction between the four groups in the achievement test, which **results in the acceptance of the second hypothesis.**

Hypothesis[3]

The variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of content (full/partial) and the interaction between them affect the scores of graduate students in the achievement test of digital learning objects production skills.

To examine the validity of the third hypothesis, descriptive-analytical data were obtained on the performance of the students of the four research groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic). By means of measuring the performance of the research individuals in the achievement test (the cognitive aspect) of the skills of producing digital learning objects, the arithmetic means and standard deviations of the achievement test scores of the students (n=80) were calculated in light of the intelligent agent pattern and content display. The following table shows the descriptive statistics of the achievement test scores for the four groups:

Table (5) Descriptive statistics for the four groups in the achievement test

Cognitive aspect	Agent	Content display	N	M	Sig
Achievement test	Interactive	Full	20	40.65	3,924
		Partial	20	46.35	1,387
		total	40	43.50	4,095
	Dynamic	Full	20	35.70	1,418
		Partial	20	38.90	1,483
		Total	40	37.30	2,163
	Content display	Full	40	38,18	3,842
		Partial	40	42.62	4,030
		Total	80	40,40	4,508

The previous table shows the means, standard deviations and average scores of students in the achievement test for the cognitive aspect of digital learning object production skills for the four groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic), which are (40.65, 46.35, 35.70, 38.90) respectively. Moreover, the standard deviations of students' scores in the achievement test for the cognitive aspect of digital learning object production skills for the four groups were (3.924, 1.387, 1.418, 1.483) respectively. This result shows an improvement in students' performance in the post measurements in the achievement test for the cognitive

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aspect of digital learning object production skills in favor of the partial /interactive intelligent agent group. To reveal the statistically significant differences between the arithmetic means of the students' scores from the two groups (the intelligent agent pattern and content display), and the interaction between them, Two-Way Anova was used as shown in Table (6):

Table (6)

Two-way ANOVA for the achievement test scores of the sample students according to the research variables (the intelligent agent pattern and content display)

Test	Source of variance	sum of squares	DF	M	F	Sig
Achievement test	intelligent Agent	768,800	1	768,8	142,8	0,000
	Content display	396,050	1	396,0	73,5	0,000
	Intelligent Agent Interaction with Content display	31,250	1	31,2	5,8	0.018
	Error	409,100	76	5,3		
	the total	132178,000	80			
	Corrected total	1605,200	79			

Table (6) highlights statistically significant differences at (0.05) between the mean squares of the students' scores from the two groups of the intelligent agent (interactive and dynamic) in the achievement test scores. That is, the mean squares of the intelligent agent's scores were (768,800), while the value of "F" was (142,823) in favor of the intelligent agent. It is also likely that there are statistically significant differences at (0.05) between the average scores of the students of the research sample from the two content display groups (full and partial) in the achievement test scores, where the average of the content display squares reached (396,050) while the value of "F" for the content display was (73,576). This indicates a statistically significant effect of the content display on the achievement test in favor of the content display. Additionally, there are statistically significant differences at (0.05) between the average scores of the students in the research sample due to the interaction between the intelligent agent and the content display in the achievement test scores, as the value of the mean square of the scores reached (31,250) and the value of "F" (5,805) at (0.05**).**

***Hypothesis*[4]**

There is a statistically significant difference at (≤0.05) between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects among graduate students.

To examine the validity of this hypothesis, the -test **for Paired Samples** is used to calculate the significant differences between the average scores of the pre- and post-measurements of the observation card (performance aspect) for the skills of producing digital learning objects for the four experimental groups as follows:

Table (7)

T- test and Cohen's d effect size for Significant differences between average scores of the research group in the pre- and post-measurements of the observation card (performance aspect) for the skills of producing digital learning objects

Groups	Measurements	N	Arithmetic mean	SD	T	Sig	(d) For Cohen	Effect size
Full/ interactive	Pre	20	70.55	8,185	13,9	0,000	3,111	high
	Post	20	102.90	4,090				
Partial/ interactive	Pre	20	70,60	9,276	29,0	0,000	6,500	high
	Post	20	121,10	5,830				
Full/ dynamic	Pre	20	64.00	8,169	16,3	0,000	3,653	high
	Post	20	94.70	8,572				
Partial/ dynamic	Pre	20	69.50	5,960	14,6	0,000	3,281	high
	Post	20	101.40	7,451				

****Significant at (05,0)**

Table (7) shows the following results; the values of the "t" test were respectively: (13,913, 29,067, 16,335, 14,674), and all of these values were statistically significant at a significance level of (0.05), which confirms the existence of statistically significant differences at a significance level of (0.05) between the average scores of the research sample students in the pre- and post-application of an observation card for the performance aspect of digital learning object production skills in favor of the post-application.

Also, it is evident that the average scores of the post-measurement of the four groups (full/ interactive, partial/ interactive, full/ dynamic, and partial/ dynamic) have improved (102.90, 121.10, 94.70, 101.40) respectively, if compared to their average scores in the pre-test, which were (70.55, 70.60, 64.00, 69.50) respectively. Moreover,

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the value of (T) reached (13.913, 29.067, 16.335, 14.674) respectively, which was statistically significant at (0.05).

By calculating the effect size, it was found that it reached (3,111, 6,500, 3,653, 3,281), respectively, which is a high effect, which indicates the validity of the fourth hypothesis, stating the effectiveness of designing a virtual learning environment based on the interaction between multiple intelligent agent patterns (dynamic/ interactive) and content display pattern (full/ partial) to develop the skills of producing digital learning objects (performance aspect) among graduate students.

***Hypothesis*[5]**

There is a statistically significant difference at (≤0.05) between the average scores of the students of the research groups in the pre- and post-measurements of the observation card (performance aspect) of the skills of producing digital learning objects according to the groups (full interactive / partial interactive / full dynamic/ partial dynamic) among graduate students.

To examine the validity of the fifth hypothesis, the means and standard deviations of the scores of the research groups (full interactive / partial interactive / full dynamic/ partial dynamic) were post-measured in terms of the observation card (the performance aspect) of the Digital Learning Objects Production Skills among graduate students majoring in educational technology.

Table (8)

Means and standard deviations of the scores of the research groups in the post-measurements of the observation card of the performance aspect of the skills of producing digital learning objects

Skill aspect	The group	number	Means	Standard deviations
Observation card	Full/ interactive	20	102,9000	4,08978
	Partial/ interactive	20	121,1000	5,83005
	Full/ dynamic	20	94,7000	8,57229
	Partial/ dynamic	20	101,4000	7,45089

Table (8) highlights there is a difference in the values of the averages and standard deviations of the scores of the research groups (full interactive / partial interactive / full dynamic/ partial dynamic) in post-measurements for the observation card of the performance aspect of digital learning object production skills among graduate students majoring in educational technology.

To examine this hypothesis, One-way analysis of variance method was used to detect the significance of the differences between the average scores of the observation card for the performance aspect of the skills of producing digital learning objects according to the groups (full interactive / partial interactive / full dynamic/ partial dynamic). The results are shown in the following Table:

Table (9)

One-way analysis of variance for the observation card of the performance aspect of the skills of producing digital learning objects among the research groups

Skill side	Source of variance	sum of squares	degrees of freedom	Mean squares	value of "f"	Sig
Observation card	Between groups	7653,350	3	2551,117	56,781	0,000
	Within groups	3414,600	76	44,929		
	Total	11067,950	79			

Table (9) indicate statistically significant differences in the observation card of the performance aspect of the skills of producing digital learning objects between the arithmetic averages of the four study groups (full interactive / partial interactive / full dynamic/ partial dynamic), as the value of "F" reached (56.781), which is statistically significant at the significance level (0.01).(To reveal the source of these differences, the Scheffe test for multiple comparisons was used, and the table shows these results:

Table (10)

Scheffe **values for the differences between the arithmetic means of the four study groups for the observation card of the performance aspect of digital learning object production skills**

Skill side	Groups	Average	Full/ interactive	Partial/ interactive	Full/ dynamic	Partial/ dynamic
Note card	Full/ interactive	102,9000	-	18,20000*	*8,20000	1,50000
	Partial/ interactive	121,1000		-	26,40000*	*19,70000
	Full/ dynamic	94,7000			-	6,70000*
	Partial/ dynamic	101,4000				-

*** Significant at level less than 0.05**

Table (10) manifests that statistically significant differences were the source of these differences in the four experimental groups, as their arithmetic average reached

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(121,1000) in the first place in the partial/ interactive agent group, the full/ interactive group reached an average (102,9000) in the second place, the partial/ dynamic group came in third place, as its average reached (101,4000), and finally the full/dynamic group reached an average of (94,7000). This confirms the interaction between the four groups in the performance aspect observation card.

***Hypothesis*[6]**

The variables of the multiple intelligent agent (Dynamic/ Interactive) and the display of content (full/partial) and the interaction between them affect the scores of graduate students in the observation card (performance aspect) of the skills of producing digital learning objects among graduate students.

To examine the hypothesis, descriptive-analytical data were obtained on the performance of the students of the four research groups **(full interactive, partially interactive, full dynamic, partial dynamic).** The arithmetic means and standard deviations of the observation card scores of the students (n=80) were calculated, according to the two groups of **Intelligent Agent (dynamic /Interactive)** and **Content display mode (full/partial).** Table (11) shows the descriptive statistics of the scores of the observation card for the performance aspect of the skills of producing digital learning objects among the four groups.

Table (11)

Some descriptive statistics for the four groups in the observation card

Cognitive aspect	agent	Content display	Number	Means	Standard deviation
Observation note card	Interactive	Total	20	102.90	4,090
		Partial	20	121,10	5,830
		Sum	40	112.00	10,471
	Dynamic	Total	20	94.70	8,572
		Partial	20	101.40	7,451
		Sum	40	98.05	8,623
	Content display	Total	40	98.80	7,822
		Partial	40	111.25	11,963
		Sum	80	105.03	11,836

The previous table shows the arithmetic means of the scores of the research sample in the two groups of **multi-intelligent agent (dynamic /Interactive)** and the groups of **content display (full/partial).** The arithmetic means of the scores of the four research groups were (102.90, 121.10, 94.70, 101.40) respectively. The standard deviations of the scores of the four research groups were (4.090, 5.830, 8.572, 7.451) respectively. To reveal the significance of the statistical differences between the arithmetic means of the scores of the students in the two groups of **multi-intelligent agent (dynamic /Interactive)** and the groups of **content display (full/partial)** and the interaction between them, the researcher used the **Two Way ANOVA a**s shown in table (12).

Table (12)

Two Way ANOVA for the observation card scores of the study sample groups according to the research variables

Test	Source of variance	sum of squares	Df	M	f	Sig
note card	Intelligent Agent	3892,050	1	3892,050	86,627	0,000
	Content display	3100,050	1	3100,050	68,999	0,000
	Intelligent Agent Interaction with *content display	661,250	1	661,250	14,718	0,000
	Error	3414,600	76	44,929		
	Sum	893488,000	80			
	Corrected sum	11067,950	79			

Table (12) reveals that there are statistically significant differences at (0.05) between the average squares of the scores of the research sample among the two agent groups (interactive and dynamic) in the observation card scores, where the average squares style of the intelligent agent scores was (3892,050) and the value of "F" (86,627), which is significant at the 0.01 level. It is also apparent that there are statistically significant differences at (0.05) between the average scores of the students in the research sample from the two content display groups (full and partial) in the observation card scores, where the average squares of the content presentation scores reached (3100,050) indicating a statistically significant effect, as the value of "F" reached (68,999). Meanwhile, there are statistically significant differences at (0.05) between the mean squares of the students' scores in the research sample, which was (661,250). In effect, it reveals the interaction between the intelligent agent and the content display in the observation card scores where the value of "F" reached (14,718) at the significance level **(0.05).**

For the findings of the final product evaluation card (learning module with digital learning objects), there is

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a discrepancy between the results of the research sample students, where the highest score was (21) with a percentage of (91%), and the lowest score was (14) with a percentage of (61%). However, most students' scores are noticeably high, as the average performance of the research sample in the product evaluation card was (17.45) with a percentage of (76%).

Discussion

The treatment of the experiment proves effectiveness of the treatment, which is the virtual learning environment based on the two patterns of the multi-intelligent agent (interactive/dynamic) and the two patterns of content display (full/partial), in developing the cognitive aspect of the skills of producing digital learning objects for graduate students specializing in educational technology, for the following considerations:

-Learning through the virtual learning environment based on the intelligent agent and the content display pattern allows diversifying learning styles that suits the learning methods and attracts students. In turn, students have a positive and effective role in obtaining knowledge related to the skills of producing digital learning objects using the program (Articulate Storyline3).

-The presence of the two patterns of intelligent agent within the virtual learning environment helped enrich the educational material and provide an enjoyable educational experience for students based on providing support and guidance. It had an effective impact on the development of the cognitive and skill levels of students, especially students using the interactive intelligent agent, which is primarily based on providing immediate feedback that helps the learner identify the strengths and weaknesses in the content of the educational material.

The content display styles within the virtual learning environment helped learning and raised students' cognitive levels. The results were in favor of the partial content display style in developing the cognitive and skill aspect of digital learning object production skills.

The results of the current study, which were in favor of the partial content display style, agreed with Hasnaa El-Tabbakh and Aya Talaat (2019); Amira Hegazy (2019); Iman Sabry and Nevin El-Gabbas (2020) that confirmed the superiority of the partial content display style. Conversely, the current study differed with some studies that indicated the superiority of the full content display style, such as Ismail Hajjaj (2017); Ashraf Abdel Latif (2017); Marian Milad (2017); Munira Ghanem (2018); Amin Abdel Maqsoud (2021); and Hanan Ammar (2022). Yet, Mohamed Saqr (2010); Osama Handawi (2013); Anhar Al-Imam and Nevin Mansour (2018) agreed that there are no significant differences between the two patterns of content display.

Moreover, students' interaction and enthusiasm in learning about the skills of digital learning objects using the program (Articulate Storyline3) was helpful and motivating in the educational process and had an impact on increasing enrichment knowledge, which was reflected in the level of students' performance in the post-cognitive test. This necessarily conforms to the principles of constructivism and social communication theory in that learning occurs within a social context and allows the student's positivity and interaction with the educational material to build new knowledge.

This result is consistent with the findings of many studies, including (Ahmed Abdel Nabi, 2018; Marwa Tawfik et al., 2016; Israa Badran, 2018; Reham Al-Ghoul, 2018; Salwa Al-Masry, 2020; Noha Mahmoud and Mai Gamal, 2023; Walaa Abdel Hadi et al., 2023), which concluded that employing the intelligent agent was effective in developing many necessary skills for graduate students majoring in educational technology for their future engagement in the labor market.

Conclusion

The study concluded the following:

- There is a noticeable effect due to the intelligent agent style (interactive/dynamic) in the current virtual learning environment in developing the skills of producing digital learning objects and deep understanding among graduate students majoring in educational technology in favor of the intelligent interactive agent style.
- There is a noticeable impact due to the content display style (Full/ Partial) in the current virtual learning environment in developing the skills of producing digital learning objects and deep understanding among graduate students majoring in educational technology in favor of the partial content display style.
- There is an effect of the interaction between the intelligent agent style (interactive/dynamic) and the content display style (full/partial); in favor of the research group (interactive educational agent style/partial content display style) in developing the skills of producing digital learning objects and deep understanding among graduate students majoring in educational technology.

Suggestions for further research:

1- Conducting more research on the style of organizing the display of appropriate content in e-learning environments in general and virtual learning environments in particular to choose the appropriate ones for students according to their cognitive preferences and appropriate learning style.

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2- The need to focus on developing deep understanding skills, which are one of the main skills that learners need to develop at the present time, in line with the challenges of the modern digital age and in line with the comprehensive design of education.

3- Paying attention to the design of the intelligent agent and its various patterns (dynamic and interactive) according to educational, technical and technological standards in order for it to play its expected role within different learning environments of attracting the attention and motivating students and guiding and directing them within those environments.

4- Directing the attention of educational designers to the significance of using the patterns and styles of the intelligent agent (Dynamic/ Interactive) according to educational and technical standards to design and produce virtual learning environments, considering the patterns and methods of presenting content (full/partial).

5- The need to direct the attention of teachers and graduates of colleges of education in various specializations to the need to have the skills of designing and producing digital learning objects through many and varied programs such as the program (Articulate Storyline3).

6- Interest in providing designers and developers of virtual learning environments with a set of guidelines when designing and planning to include the intelligent agent in these environments; and considering the method of presenting educational content.

7- Training teachers to use virtual learning environments and employ them in the teaching and learning process.

8- The need to introduce intelligent learning environments based on artificial intelligence in teaching and education within the development plans of the Ministry of Education to achieve the effectiveness and efficiency of the teaching process.

9- Adopting plans for continuous training and development on technological innovations for the skills of producing and designing digital learning objects through workshops supervised by specialized entities.

10- Employing the fields of artificial intelligence in the field of learning such as employing artificial intelligence patterns within intelligent learning environments and systems and creating new designs in learning and teaching and using them as a modern trend in learning graduate students in general and educational technology students in particular.

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

Competing interests:-

The authors declare no competing interests

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