بيئة تعلم تكيفية قائمة على المحاكاة التفاعلية لتنمية بعض مهارات التفكير العليا في قواعد البيانات لدى طلاب إعداد معلم الحاسب الآلي

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المستخلص:

هدف البحث الحالي إلى قياس أثر بيئة التعلم التكيفية القائمة على المحاكاة التفاعلية في تنمية مهارات التفكير العليا لدى الطلاب في قواعد البيانات والتعرف على مدى فاعليتها، وقد تكونت عينة الدراسة من (34) طالباً وطالبة من طلاب المستوى الأول بقسم إعداد معلم الحاسب الآلي بكلية التربية النوعية جامعة دمياط والمسجلين في مقرر قواعد البيانات، وتوصلت الدراسة إلى قائمة مهارات التفكير العليا في قواعد البيانات، واعتمدت الدراسة على اختبار مهارات التفكير العليا بعد توحيدها، وقد تم التحقق من ثبات الاختبار باستخدام ألفا كرونباخ (0.812)، وتم استخدام اختبار (ت) للعينات المرتبطة لتحليل درجات الاختبار القبلي والبعدي، حيث أشارت النتائج إلى وجود فروق ذات دلالة إحصائية عند مستوى الدلالة (0.01) بين متوسط درجات عينة البحث في القياس القبلي والبعدي لاختبار مهارات التفكير العليا لصالح التطبيق البعدي كذلك وجود أثر كبير يصل إلى (97.6%) مما يدل علي أن بيئة التعلم التكيفية المبنية على المحاكاة التفاعلية لها أثر إيجابي على تنمية مهارات التفكير العليا لدى الطلاب في قواعد البيانات.

الكلمات المفتاحية: التقييم الإلكتروني – المحاكاة التفاعلية – بيئة التعلم التكيفية

Adaptive Learning Environment Based on Interactive Simulation to Develop Some Higher-Order Thinking Skills In the databases of computer teacher preparation students

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Abstract:

The current research aims to measure the effect of an adaptive learning environment based on interactive simulation to develop higher-order thinking skills among university students in databases and to identify its effectiveness. The study sample consisted of (34) male and female first-level students in the Computer Teacher Preparation Department, College of Specific Education, Damietta university who were registered in the databases course.
The study came up with a list of higher-order thinking skills in databases, and the study relied on testing higher-order thinking skills after standardizing them. The Stability of the test was reached using Cronbach's alpha (0.812). The paired samples t-test was used to analyze the pre- and post-test scores. The results indicated that there were statistically significant differences at the level of significance (0.01) between the average scores of the research sample in the pre- and post-measurement of the higher-order thinking skills test in favor of the post-application had a large effect amounting to (97.6%). These results indicate that the adaptive learning environment based on interactive simulation has a positive impact on developing students' higher-order thinking skills in databases.

Key Words:
E assessment- Interactive Simulation -Adaptive Learning Environment.

1. Introduction

Education consists of several units that are linked to each other and affect each other. Evaluation is the most important and influential component of education, Because the Evaluation is considered the leader that leads the educational system to development. Evaluation is considered one of the most important criteria for measuring progress in the learning and teaching environment [1]. The evaluation process aims to know the progress made by the learner based on the new knowledge and skills presented to him [2]. Where the evaluation results are used to ensure that the desired learning and development outcomes are reached, future plans are made, and motivation is increased towards learning [3]. Therefore, the evaluation must have special and specific specifications and standards so that the strengths and weaknesses of the educational process can be identified [4]. Each student has a different learning style commensurate with his personal characteristics [5]. And with applying of modern strategies in education based on e-learning, which many educators advocate, modern methods of evaluation should be adopted that are suitable for this type of education [6] especially in the presence of large numbers of students in the classrooms.

As the increase in the number of groups of students increases the workload of teachers, whether in distributing and collecting tasks on students, exams, monitoring, correction and taking notes [7], therefore it is necessary to search for strategies to reduce the burden of these tasks on teachers, especially evaluation procedures, E tests are used as an alternative to paper exams as one of the effective tools for applying the assessment process in line with the new developments of e-learning applications via networks [8]. Database design is an important area associated with the category of information systems developers [9]. Universities have the task of training increasing numbers of students to work in the field of designing and maintaining databases, which is an essential part of all information systems [10]. in Egypt, Universities require students to take a course of ICDL to obtain a graduation certificate, and the database course is one of their basic modules. In the world of information technology that we live in today, database skills are among the basic skills that students need for their practical life, and despite that, there is a big gap between the required skill levels and that students already possess, therefore a number of researchers agreed that the best way to acquire database skills is to simulate the real environment that contains problems that need to be fixed instead of following steps [11]. Therefore, this study proposes an adaptive assessment environment based on simulating the original environment in the field of computer learning to Develop higher-order thinking skills for students in Learning about databases.

2. Theoretical backgrounds

2.1 The Learning Problems in Database Design

Many researchers dealt with the problem of students facing many difficulties in academic achievement of databases. The study of [12] indicated that interest in teaching method of database still is more than interest in practical skills for students, and this leads to poor understanding by students and loss of ability to practical after the end of the study. Studies [13][14][15][16] have indicated that students facing difficulties in learning databases. A study [17][18] indicated that students face difficulties in learning database design because of its abstract nature, which causes them difficulty in understanding and realizing. in [18] suggested the use of courseware based on animated to treat the problem of difficulty learning database design, while [19] suggested the use of Constructivist Learning Environment based on the web to solve this problem. in [19] was mentioned that the modern methods used in databases depend learning based on ready-made, specific examples, and prepared in advance by the teacher, and this gives the student the necessary skill to create databases, but the comprehensive picture of the database remains far from the cognitive awareness of the students. while [13] pointed out that the actual practice in database systems is completely different from the simple information that students obtain in the database courses. A study [20] indicates that some students face difficulties in converting conceptual design into logical design through traditional teaching, and as a result, students lose motivation to learn. This study suggested project-based learning method as a solution to this problem. While the [21] study confirmed that one of the most important difficulties facing students in the field of databases is the inability of students to apply what they learn in these courses with the actual market Special requirements. The reason for this problem may be due to how much was indicated in a study [22] which that showed the lack of interest in developing the creativity, development and innovation skills for these students.

2.2 Higher order Thinking skills in Database Learning

Higher-order thinking skills refer to the ability to achieve targeted goals through different types of thinking, such as analytical, critical, and creative thinking [23]. While analytical thinking is defined as the ability to classify educational elements, evaluate the relationships that link them, and the ability to identify the most important procedures and work to organize them [24]. Critical thinking refers to the ability to take appropriate and more accurate actions to solve problems and evaluate different things and situations [25]. While creative thinking refers to the ability to use previous knowledge to discover or create new things to solve problems and stimulate performance [26].

Higher order thinking skills focus on the thinking that occurs at the higher levels of the knowledge hierarchy, where thinking progresses from thinking at the knowledge level until it reaches thinking at the evaluation level. theoretical Knowledge and empirical help improve students' critical thinking [27]. In order to develop critical and creative thinking among students, questions can be used as a tool to enhance problem-solving skills and come up with new ideas [28]. The authentic content environment can be used to improve the ability to think critically, enhance learning, motivate students to participate in the learning process positively, and develop cooperation and communication skills [29]. Experimental-based education improves understanding and develops students' higher-order thinking skills and scientific knowledge [30].

2.3 Simulation in Education

Simulation is an effective strategy in education as it helps develop learners' knowledge and skills when compared to traditional teaching methods or no teaching [31]. Expertise growth theories indicate that reducing students' theoretical knowledge and increasing practical enables them to gain greater experience in solving complex problems [32]. Simulation is considered a type of role-playing of a real situation, which contributes to students' self-education of the educational materials used, and this benefits the learners in the learning materials they study [33]. Some teachers point out that the poor performance of students in educational situations may be caused by the abstract nature of the scientific subject or the lack of sufficient educational materials for teaching. Therefore, the use of simulation is an educational method that focuses on the characteristics of the learner and combines different styles of representing knowledge, such as visual and kinaesthetic learning. by providing simplified models of real-world elements [34]. Simulation allows the development of basic skills through trial and error in a safe and controlled environment, because the opportunities to participate in solving realistic problems are limited and are stressful for students [35]. then simulation learning may be the most appropriate solution for professional development for university students [36].

2.4 Assessment Methods Which Using in Database

One of the most important methods used to measure the effectiveness of teaching is evaluation. Where students' motivations towards learning differ according to different assessment methods [37]. In [38] indicates that students' learning motives and their desire to achieve are linked to the assessment forms that are presented to them, as some assessment increase motivation for learning, increase interest in learning, and motivate students to perform better. while [39] points out that students often determine how they

should direct their efforts in learning and what they need to learn based on assessment methods which presented to them. assessment is defined as collecting information using various tools based on the progress made by the learner in the learning process and making decisions accordingly. There is no doubt that these decisions have a significant impact on the level of the learner's performance and his competence in carrying out certain action and tasks [40]. In light of the information and communication revolution, evaluation is no longer a means to determine the success of learners and their transition to higher grades or advanced stages. This requires a shift from traditional evaluation methods, which are limited to comparing the learner's performance with that of his peers, to modern assessment methods that work on integrated personality development [41]. At the present time, the assessment methods of databases based on combining theoretical tests with practical tests on the computer [22]. Theoretical tests are a way to arrange students according to their achievements. Theoretical tests, which are often multiple choice or short answers, focus on providing students with low-level cognitive skills because they depend on measuring the learning. approach that is concerned with transferring knowledge, memorizing by heart, and standardized tests. The theoretical knowledge after the test is quickly forgotten [42]. While the practical tests based on the computer focus on giving the student a question or a set of questions to implement on the computer and judge his performance through that, although this method allows the student to practice on the computer, but it is concerned only with the skill of operation, and students often copy the experiences of their classmates Therefore, we find a match in a large number of experimental reports submitted by students [22]. The current educational goals focus on educating students and developing their skills for work and life, and this cannot be achieved by using traditional assessment methods, which do not link theoretical knowledge with practical performance, which makes the study boring and abstract for students [43]. Therefore, there is a need for assessment methods that develop transferable knowledge and skills, such as problem-solving skills, critical thinking, creative thinking, and others. Therefore, this study provides a simulation-based assessment environment and a problem-solving approach to develop students' higher-order thinking skills to improve their skills for Continuous learning.

3. METHODOLOGY

3.1 Purpose of the Study

In this study, the effect of the simulation-based adaptive assessment environment on developing students' higher-order thinking skills and students' attitudes toward the adaptive assessment environment was studied. The study used the levels of analysis, synthesis, and evaluation in Bloom's classification of cognitive skills as a basis for higher-order thinking skills.
This study attempts to answer the following questions:
What is the effect of using the simulation-based adaptive learning environment on students' higher-order thinking skills? The following questions fall under this question.

1- How can a proposed environment be built based on interactive simulation to develop higher-order thinking skills among students of the Computer Teacher Preparation Department, Faculty of Specific Education, Damietta University?

2- Does the use of the adaptive learning environment based on interactive simulation of the real environment have a positive effect on the development of students' higher-order thinking skills in databases course?

The program's Story Line3 was used with Visual Basic programming to develop the application. Figure 1 shows the structure of the proposed environment the application's work flow chart.

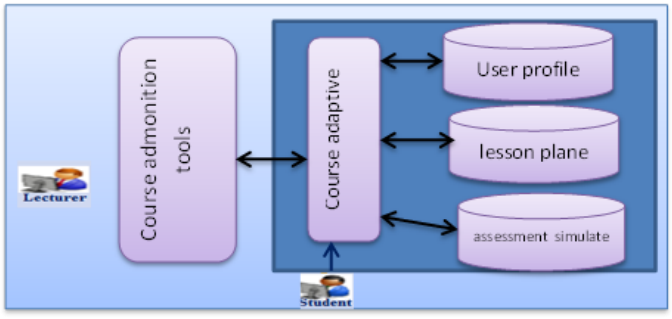


fig.1 The structure of the proposed environment

The proposed environment is considered an environment for developing higher-order thinking skills (analysis, application, and evaluation) in learning databases. It can be accessed through public browsers and run over the Internet to enhance the learning and teaching tasks of students and lecturers. Table 1 shows the basic functions of both students and teachers as flow.

Table 1 shows the basic functions of both students and teachers

User	Component	Functionality
Teacher	Profile	log in.
	Create Subject	Create a new lesson.
	Project management	Editing content, questions, inserting videos , images, and simulations of specific steps.
	Simulation	Allows create and uploading simulations.
	Social media API	Allow users use these interactive tools in the system pages.
	Mail box	Send message to exchange ideas, or other information.
Student	Profile	log in.
	Select lesson	Clicks to navigate to another screen.
		User obtains course information.
		Selects a lesson to enroll in.
		Can learn the lesson.
	Simulation	simulation Cannot progress until the response Quiz is completed.
		Executing simulations.
	Mail box	Send message to exchange ideas, or other information.
	My group	Enable students to join groups by social media .API

Figure 2 shows flow chart for scenario board of proposed environment.

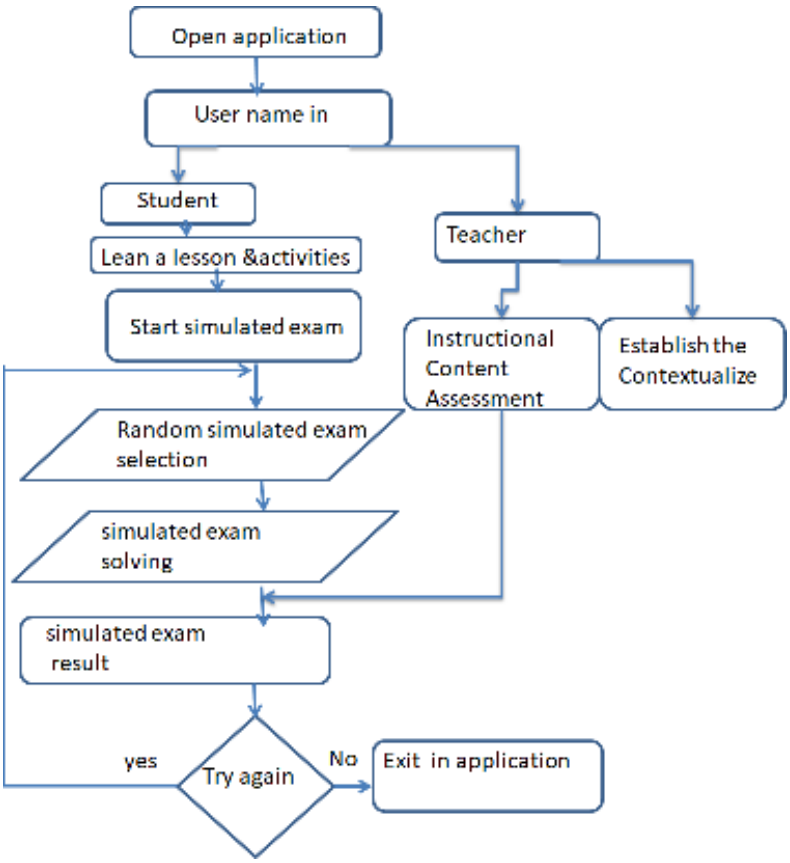


Fig. 2 flowchart of scenario board of proposed environment

The basic application modules consist of student and teacher modules, which include three parts: Profile, educational content, and assessment tools.

a- Profile

The application requires users to register their names the first time to log in, and after that their names will appear when they log in later, and students can enter the student unit through which they can select a lesson, deal with its various activities, and assessment tools. The application includes a database to store users' personal data.

b- Educational Content

The educational content is closely linked to the elements of the lesson. It provides a set of teaching tools to help lecture and students manage learning through the ability to display objectives, edit textual information, insert interactive videos and interactive simulations, and add social media destinations such as Twitter, Facebook, and YouTube to subscribe to Groups help increase interaction between lecture and students, in addition to the possibility of using e-mail.

c- Assessment Tools

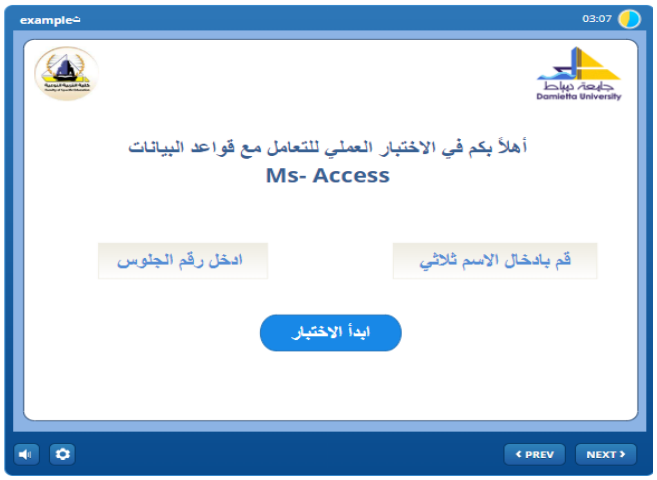
The system allows storing an assessment for students, and while watching the interactive video, the student can answer the questions presented to him, so that if the answer is correct, he moves to the next part in the interactive video display, and if the student answers incorrectly, the video display begins from the beginning of the educational element and after completing the content. In the lesson, the student can take an assessment to measure the student's higher-order thinking skills. These tests were designed and created and presented to a group of arbitrators to ensure the validity and reliability of the test. Then these tests were created in the system and collected in a database. When the student logs in to the test 10 questions are randomly selected as a component of the test from the question database. The student answers them in a specific time, and a report of the test result is displayed. Therefore, the application supports both formative and summative assessment for students.

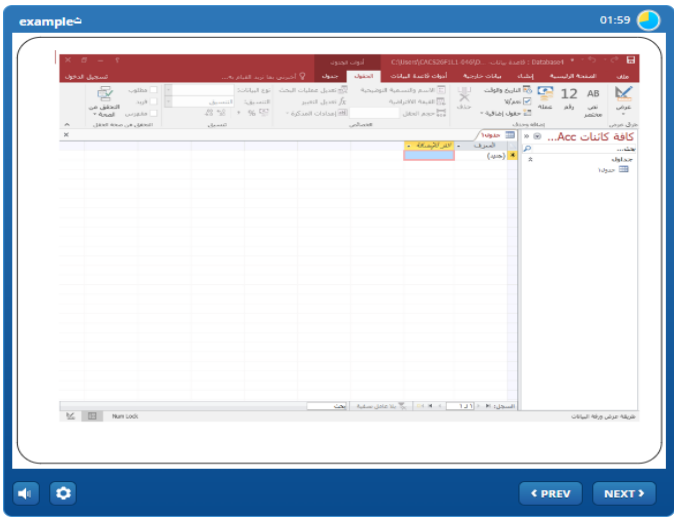
3.2 Proposed environment GUI

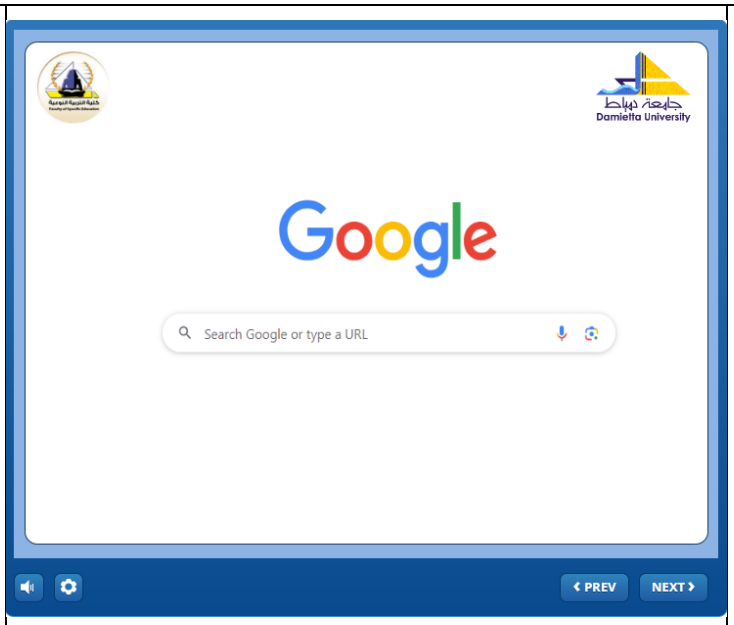
The following section presents the scenario for the proposed environment, which includes a number of snapshots of the different interfaces, which include basic elements such as the home page, educational objectives, interaction tools, educational activities, and assessment tools. Table 2 shows some examples of the implementation scenario for the proposed environment.

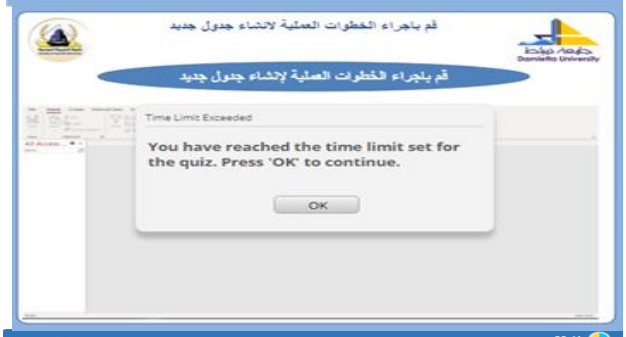
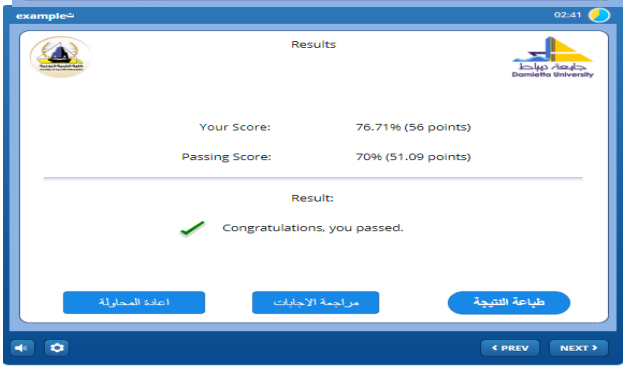
Table 2 shows some examples of the implementation scenario for the proposed environment

No	Snapshot	Description
1		This screen contains the basic data for the application, including the address and data of the researchers.

2		This screen contains your login information.
3		The main window contains links to general goals and content, boxes for questions, the plan, online research, simulation, e-mail, joining discussion groups, starting the test, and interactive video.
4		Content: Lesson elements. Each lesson includes text, still images for the lesson, and links to boxes for questions, planning, online research, simulation, email, joining discussion groups, and starting the test.

5		Simulation provides a tool through which the student can carry out a simulation of practical models of educational elements (creating a table, for example, by displaying an Access window and performing the simulation).
6		Join discussion groups on Facebook, Twitter, or Instagram.
7		Interactive video: An interactive video is shown to explain the educational element. During the presentation, he is given a question that he answers, and if his answer is correct, he continues watching the rest of the elements and other questions are shown to him, and so on, and if his answer is wrong, he returns to the first presentation of the educational element.

8		Searching the Internet, where you can search for various information through the learning environment.

9	    	Starting the test: It includes a login screen for the test, then after entering, he is presented with a test consisting of 10 questions presented to him randomly from the question bank. The window is divided into two parts. The top of the window contains a timer for the test time and the question, such as (state whether the following statement is true or false, then do by implementing practical procedures for it, such as: “Can we change the student’s seat number field to the student’s name while keeping its type?” And the other part of the window is the answer area, which contains screens for the Access program through which it can simulate the practical procedures for the solution. At the end of the test, it is displayed the test result by displaying the score obtained and the percentage of incorrect questions, displaying a report on the test questions, and reviewing the answers with the ability to print the result.

3.3 Participants

The participants were students from the Computer Teacher Preparation Department, Faculty of Specific Education, Damietta University. 60 students were randomly selected from among 200 students who registered for the first-year database course. They were divided into two groups, a control group consisting of 30 students and an experimental group also consisting of 30 students. With the experimental group, we used the simulation-based adaptive assessment environment, and with the control group, we used paper-based tests. The experiment was used on the "Tables" module of the Microsoft Access course for the academic year 2022-2023.

3.4 Study Tools

3.4.1 List of higher-order thinking skills in Access databases

This tool aimed to identify a set of higher-order thinking skills related to the tables and queries chapters in the databases course for first-year students in the Computer Teacher Preparation Department. In its initial form, the list consisted of three main skills: discrimination skills, inference skills, and evaluation skills. Under each main skill there are a number of sub-skills. The number of sub-skills reached 12 skills .The list was presented to a group of arbitrators (8) in the field of in computers, curricula, and teaching methods. To express their opinions about: the extent to which the sub-skills relate to the main skill to which they belong, the suitability and importance of each of these skills for first-year students in computer teacher preparation Department Based on the opinions of the arbitrators, the relative weight of higher-order thinking skills in the database course was calculated, Table 3 shows the relative weight of the list of higher-order thinking skills, database course, tables and queries chapter.

Table 3 the relative weight of the list of higher-order thinking skills, database course, tables and queries chapter

Higher-order thinking skills in the database course	How important it is?			Great value	Relative weight
	Important	No important	To some extent		
First, discrimination skills, which include the following skills:					
1-distinguishing between types of fields in tables	6	1	1	21	2.625
2- Identify similarities and differences between tables and queries	6	2	0	20	2.5
3- Classification of types of relationships in tables	6`	0	2	22	2.75
4- Differentiate between types of queries	5	1	2	20	2.5
Second: inference skills, which include the following sub-skills					
5- Formulating a comprehensive concept for databases	6	2	0	20	2.5
6- Highlighting the comprehensive relationship between tables and multiple types of queries	6	2	0	20	2.5
7- Representation of some conditions in queries	5	1	2	20	2.5
8- conditions inference that can be applied to data tables	7	0	1	23	2.875
Third: Evaluation skills, which contains the following:					
9- Judges the table designs needed for a database project	6	2	0	20	2.5
10- Determine the accuracy of the criteria used in queries	6	0	2	22	2.75
11- interprets the results of various queries	6	1	1	21	2.625
12- Judge errors in table structures	5	2	1	19	2.325

3.4.2 A Higher-order Thinking Skills Test

In light of the general procedural goals of developing some higher-order thinking skills in Access databases, a higher-order thinking skills test was designed and built based on interactive simulation. The higher-order thinking skills test went through several stages in its preparation as follows:

1- Determine the purpose of the test

The higher order thinking skills test was prepared with the aim of measuring the achievement of a sample of students from the Computer Teacher Preparation Department at Damietta University in the higher order thinking aspects of the knowledge pyramid for the database course, by applying it pre – posttest on an experimental group.

2- Determine the type of test items and their wording.

3- After reviewing the references and studies that dealt with evaluation methods, tools, and objective and essay tests in particular.

It was found that objective tests that rely on multiple choice questions which depend on memorizing and retrieving information are not suitable for developing higher-order thinking skills among students due to the ease of reaching the answer and because they depend on developing lower-level cognitive skills that. Therefore, the type of test items was determined, such as What happens if in multiple choice and true-false questions, because they depend on evaluating the student's understanding and ability to think, which helps measure the students' higher-order thinking skills. In light of this and in light of the list of higher-order thinking skills that was prepared and related to the database course, the items for the higher-order thinking skills test was initially formulated to cover all cognitive aspects related to the levels of analysis, composition, and evaluation of the database course (tables and queries unit), The number of test items reached 36, three test items to measure each of the higher-order thinking skills in the list of higher-order thinking skills. **Test instructions It is a guide that the student uses in order to be able to perform the test correctly, and it is as follows:**

1- A clear, concise and accurate introduction to the test.

2- How to answer the test questions.

3- Test time.

4- The number of test items.

5- The total score of the test.

4- Determine the test time

By conducting a reconnaissance experiment on a number of (10) students outside the research sample, the time taken by the first and last students to finish answering the test was calculated, and the average was calculated, as it was found that the test requires 40 minutes.

5- Calculating discrimination, ease, and difficulty coefficients for test items

The goal of calculating the discrimination coefficient is to know the ability of each test question to distinguish between high performance and low performance for members of the study sample. The ability of the item to distinguish was calculated using the equation of the item's discrimination coefficient, where (an item's ability is considered indistinguishable if its discrimination coefficient is less than 0.2), By calculating the coefficient of discrimination for the test items, it was found that it ranges between (0.46, 0.82), which is within acceptable limits. The minimum coefficient of discrimination in a good test is (0.2). It uses the ease and difficulty coefficients of the test items to delete items that are extremely easy or difficult, and whose ease or difficulty coefficient is less than 20% or 80% or more. By calculating the ease and difficulty factor for each item in the achievement test, it was found that the lowest ease factor was (0.46), and the largest ease factor was (0.82), and these results are within the limits of what is permissible for someone to accept the item and include it in the test.

6- Validity of the test

The validity of the test was determined by presenting it to a group of arbitrators specialized in the field of curricula, teaching methods, and computers, with the aim of seeking guidance from their opinions about the test's coverage of a wide range of theoretical content of the database course. The linguistic correctness of the formulation of test questions, and the ease and clarity of the questions. Figure 3 shows the rate of agreement of the arbitrators regarding the achievement test.

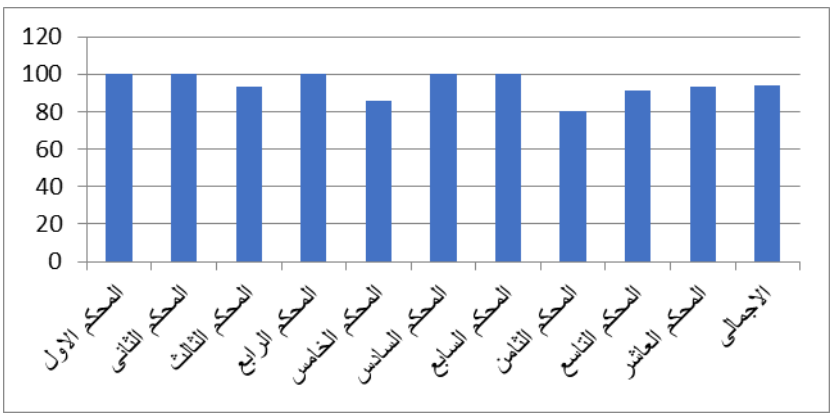


Fig. 3 Percentage of arbitrators' agreement on the higher-order thinking skills test

The comments of some of the arbitrators included reformulating some questions, deleting some questions, and adding others to achieve the goal of the test, and modifications were made.

7- Stability of the test

The internal consistency coefficient (Cronbach's alpha) was used to ensure the stability of the higher-order thinking skills test as a whole, as the value of the alpha coefficient reached (0.812). This percentage is considered high, which confirms the stability of the test and its validity for application. After confirming the stability and validity of the test It was used.

4. Results and Discussion

The current study reached a number of results that we will review in the next section, and will interpret and analyse these results. To determine the extent to which students mastered higher-order thinking skills in the database course, a pre-test of higher-order thinking skills was applied and corrected. The level of achievement as a whole was divided into (low - medium - high) levels During the calculation of the range and its dimensions according to the observed data as a result of applying the pre- test of higher order thinking skills according to the following equations:

Range = (total test score - smallest value).

Class length = (range 1+ / 3)

Accordingly, the responses were divided into three levels as follow:

-Low level: from lowest grade to less than (smallest grade + length of category).

-Intermediate level: from (smallest score + length of category) to less than (smallest score + Class length * 2)

- High level: from (smallest score + (category length * 2) to (smallest score + (Category length * 3)) and more.

Table 4 shows the results of the three levels of applying the pre- test of higher-order thinking skills

Table 4 shows the results of the three levels of applying the pre- test of higher-order thinking skills

Test level	Number	M	SD	%
low (0-12)	24	6.77	3.99	.7060
Medium (12>24)	10	16.5	3,07	.2940
High (more than 26)	0	0	0	0

It is clear from the previous table that students were unable to master higher-order thinking skills in the database course, as the percentage of (0.706) students at the low level reached, while the percentage (0.294) at the intermediate level reached such. This indicates a clear weakness in these skills.

To answer the second question of the study, the hypothesis was tested which indicates: There are statistically significant differences between the average scores of the pre- and post-tests in the higher-order thinking skills test for the database course among first-year students in the Computer Teacher Preparation Department in favour of the post-test. To verify the validity of this hypothesis, the difference between the pre- and post-test of the experimental group's performance in the higher-order thinking skills test in databases was calculated using the paired samples t-test. The study reached the result shown in the following table:

Table 5 The t-test for the difference between the average scores of students in the pre, post- test for the experimental group students in the sub higher order thinking skills -test in the database course

Skills	Test	Number	Mean	SD	σM	t-value	Freedom degree(df)	Significance	Difference in Mean Values for Pre- and Post-tests	Trend of Differences
Discrimination	Pre	34	5.54	1.581	.224	27.289	33	0. 01 Significant	6.840	in favour of the post-test
	Post	34	12.38	2.672	.378					
Inference	Pre	34	4.82	1.935	.274	29.309	33	0. 01 Significant	7.800	
	Post	34	12.62	2.381	.337					
Evaluation	Pre	34	4.02	1.505	.213	22.336	33	0. 01 Significant	4.800	
	Post	34	9.82	1.366	.193					
Total score	Pre	34	12.38	3.943	.558	33.212	33	0. 01 Significant	19.440	
	Post	34	31.82	5.759	.815					

It is clear from the data in Table No. 5 that: The mean scores of the students in skills of discrimination level reached (5.54) with a standard deviation (1.581) in the pre-test, while the mean scores of the students in the post-test reached (12.38) with a standard deviation (2.672) and the value of the t-test reached (27.289) and since the differences between the mean scores of the students in the pre- and post-test (10.909) > 1. This indicates that there are statistically significant differences between the mean scores of the students in the pre- and post-test in favour of the post-test. In inference skills, the mean scores of the students in the pre-test reached (4.82) with a standard deviation (1.935) while their mean scores in the post-test reached (12.62) with a standard deviation (2.381) and the differences between the mean scores of the

students in the pre- and post-tests reached (5.8) while the value of the t-test reached (29.309) Significance level (0.01). This indicates that there are statistically significant differences between the mean scores of students in the pre- and post-tests in favour of the post-test, and that these differences are not due to the size of sample. at Evaluation skills, the mean scores of the students in the pre-test reached (4.02) with a standard deviation (1.505) while their mean scores in the post-test reached (9.82) with a standard deviation (1.366) while the value of the t-test reached (22.336) with Significance level (0.01). This indicates that there are statistically significant differences between the mean scores of students in the pre- and post-tests at favour of the post-test, these differences are not due to the size of sample whereas to the differences between the mean scores of the students in the pre- and post-tests which reached (4.8). Regarding the mean of the test as a whole, there are statistically significant differences between the mean of the pre-test and the post-test in favour of the post-test, as the percentage of the mean of the post-test was (31.82) compared to (12.38), while the value of the t-test of the whole test reached (33.212) for the pre-test. Figure (4) shows these results.

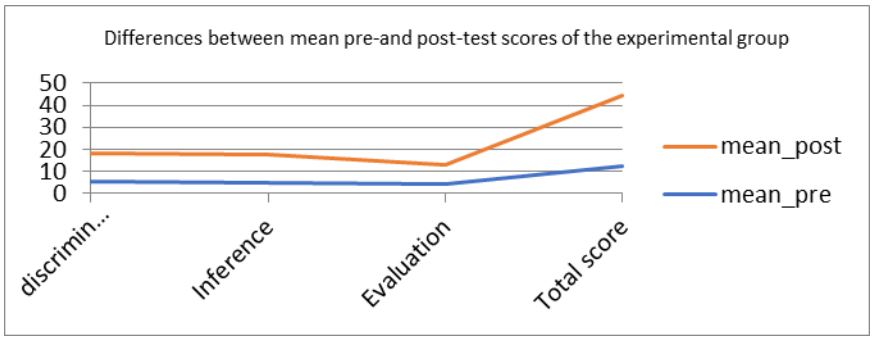


Fig. 4 Differences between mean pre-and post-test scores of the experimental group

4.1 Measuring the size of the effectiveness of the Proposed environment

To verify the size of the effect and effectiveness of the proposed program, the researchers used two methods: Cohen's d equation and Blake's Modified Gain Ratio.

A) Cohen's d

Cohen's equation was used to ascertain the size of the effect of the independent variable (the proposed environment) on the dependent variable (development of higher-order thinking skills). Table No. (6) shows Cohen's d effect size, which shows the size of the effect of the differences between the pre- and post-tests in the three levels of thinking and the overall test scores.

Table 6 Effect size of the differences between the pre- and post-test of concepts and the total score of test

Skills	Effect Size D	Effect level
Discrimination	0.802 (80.2%)	High
Inference	0.862 (86.2%)	High
Evaluation	0.656 (65.6%)	Medium
Total score	0.976 (97.6%)	High

It is clear from the previous table that the effect size of the differences between the pre- and post-tests of discrimination skills amounted to (0.802), which is a value greater than (0.8), which is a high effect rate. For Inference skills, it reached (0.862), which is a value greater than (0.8), which is a high percentage of influence, and for evaluation skills, it reached (0.656), which is a value greater than (0.6), which is a moderate percentage of influence, and for the total test, it reached (0.976), which is a value greater than (0. 8).
This is a high impact rate, which indicates that the proposed environment has a role in developing higher-order thinking skills among participating students.

B) Blake Modified Gain Ratio

The effectiveness rate of the proposed environment was also calculated using Blake Modified Gain Ratio, Table No. (7) shows the effect ratios using Blake Modified Gain Ratio.

Table 7 Results of Blake's Gain Ratio

Skills	Modified gain	Effect level
Discrimination	1.625	Accept
Inference	1.736	Accept
Evaluation	1.210	Accept
Total score	1.363	Accept

It is clear from the previous table that the results of the Blake Modified Gain rates for the skills of distinction, Inference, evaluation, and total testing exceed the reference value (1.2) this indicates the positive impact of the proposed environment in developing higher-order thinking skills among students.

5. Conclusion

This paper presents an Adaptive Learning Environment Based on Interactive Simulation to Develop Some Higher-Order Thinking Skills In the databases of computer teacher preparation students. The proposed environment is considered for developing higher-order thinking skills (analysis, application, and evaluation) in learning databases. It can be accessed through public browsers and run over the Internet to enhance the learning and teaching tasks of students and lecturers This environment includes learning and assessing students through simulation and the use of interactive images and videos. This paper aims to measure the effect of an adaptive learning environment based on interactive simulation to develop higher-order thinking skills among university students in databases and to identify its effectiveness. The study sample consisted of (34) male and female first-level students in the Computer Teacher Preparation Department. The results indicates that there are statistically significant differences between the mean scores of students in the pre- and post-tests in favor of the post-test. And it is clear the positive impact of the proposed environment in developing higher-order thinking skills among students.

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