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**Research Article**

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# Design and Evaluate the Effectiveness of the Networking-Tutor, Intelligent Tutoring System for Teaching Students an Introduction for Computer Network in Iraq

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**Abstract** Networking-Tutor is an intelligent tutoring system that is used to teach senior students an introduction to a computer network. These systems which we mean the ITS systems have not been used widely in Iraq. In this paper, the design of this ITS has been illustrated and its evaluation has been done on senior students of Computer Network course in the faculty of Computer Engineering Department / College of Engineering at Almustansiryah University in Iraq. A pre-test has been taken by the two groups and this test shows that there is no difference in the performance between the two groups. Depending on the pre-test result, the students have been divided into two groups (control and test group). The test group used the Networking-Tutor to learn the computer network while the control group uses the traditional learning method. Another test (post-test) has been taken and showed that students who took the ITS improved much more than the other group who did not use ITS.

**Keywords** Intelligent tutoring system, intelligent agent system, intelligent coaching system, ITS

## 1. Introduction

This paper presents an experiment for evaluating the effectiveness of the intelligent tutoring system that teaches students computer network used by students in the college of engineering/ Computer engineering department at Almustansiryah University. An overview of the Networking-Tutor, the experiment methods used, and the results are presented.

The traditional learning methods that have been used for a very long time have progressed very slowly and might be unsuccessful for addressing various knowledge styles and levels of preparation. This kind of learning is characterized by a lot of students interacting with one teacher, who is incapable to address the individual requirements of every student. So, some students can become upset and fail to reach their learning potential. Intelligent Tutoring System (ITS), which is a computer software used to deliver students with one-to-one supplemental tutoring tailored to the student's education style and speed, has been of interest to scientists for enhancing student education. The use of computers in the education process has been an area of interest to learning researchers for almost a century. The goal of those scientists has been to build computing systems that help students to learn about specific fields of study. One of the first computing systems in learning, like the instructional machine of Pressey in 1926, displayed multiple-choice questions with their answers provided by teachers. Improvements in computing technology led to the introduction of artificial intelligence (AI) in these systems in the 1970s, the combination of which was called *intelligent tutoring systems* (ITS). ITS has developed, and this application can model the mental and emotional states of students with the goal of adapting and personalizing instruction [1]. These systems have been used in the learning system in many fields, such as chemistry, physics, computer science, and mathematics. Although a huge number of ITS have been evolved, a lot of these systems are used only in the research environment because of the struggle in enhancing them and the difficulty required to provide robust and flexible systems [2]. ITS can be the answer for the many problems

faced by learning systems; one of the biggest benefits of the ITS is the one-to-one education environment that it offers.

## 2. Intelligent Tutoring Systems

### A. Introduction to Intelligent Tutoring Systems

In the 1970s, artificial intelligence (AI) was used in the learning to produce beneficial computers that could be used in education. AI is the knowledge of creating machines to do things which may be considered intelligent if done by human, and it leads to more understanding of knowledge. AI teachers work with students that have diverse capabilities, allow cooperation, and integrate agents that are conscious of students' affective, mental, and social characteristics. These agents have the ability to distinguish communicate, learning disabilities and replay material to the students as needed. They monitor and lead students' improvement depending on the representation of both the public issues and content and bring about the chance of student's act. AI techniques can be called a self-enhancing teacher because the teachers can assess their own teaching [3].

The ITS is a computer software that is aimed to integrate AI in a way that it becomes a teacher that knows who, what, and how it teaches. ITS can serve the needs of the students. In other words, the ITS manages students' knowledge and assesses their potential. Today, ITS is considered a software which can support many students' requirements [4]. The main reasons we use ITS are that it offers the one-to-one learning environment, and it can address the requirements of learners.

### B. Architecture of Intelligent Tutoring System

ITS has many components that help it to do its job. Figure 1 shows the ITS architecture.

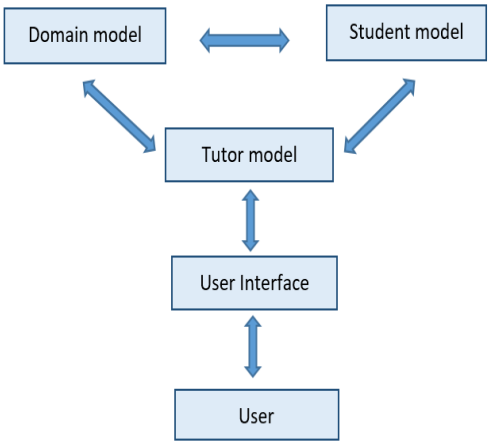


*Figure 1: The domain component of the ITS*

ITS has four different components: Domain, Teaching, Student, and Learning Environment (or User Interface, sometimes called the Communication component) [5]. The ITS presents problems for students via the Learning Environment (user interface), which is the component of the ITS that is responsible for interactive with students. Students will enter their answer to this problem through the same unit. The Domain unit has the knowledge about the topic that the ITS teaches so that it has the correct answers to the problems. The Teaching module studies the data from the students, containing the solution submitted by the students. This component depends on the data that the Domain module offers, so it can choose which solution is correct and which is not. Furthermore, the Teaching module uses the information got from the Student unit, which is responsible for gathering the information about the students' features and behavior so that it can choose which is the best feedback for any given student. Students get this feedback over the Learning Environment unit. The Student component updates itself depending on the information that has been gathered about students from these questions [6].

**3. Networking-Tutor User Interface**

In this tutor, students are presented with a problem, and a number of radio buttons which one of them has the correct answer for this problem. For example, once the student is ready to submit the solution of the problem to Networking-Tutor, the 'Check' button may be pressed. The student can request to see the hints by pressing "Hint". The "Hint" button is invisible when students see the problem for the first time because we just need to encourage students think more about the solution of the problem. A timer is set for 20 seconds so that if students spent more than 20 seconds without choosing any option, a message box will pop up asking students if they need help and the "Hint" button will be visible. Also, when students cannot go to the next problem without answering the current one. So, if students could not get that much of help from the "Hint" button, they can click on the "Explanation" button which has more explanation about the problem that can help students understand more. The "More Explanation" button will take students to many websites that have an in depth explanation for the problem. Students, at any time, may ask the Networking-Tutor to view the solution, Exit from the current problem. The Networking-Tutor user interface is shown in fig 2, 3, and 4.

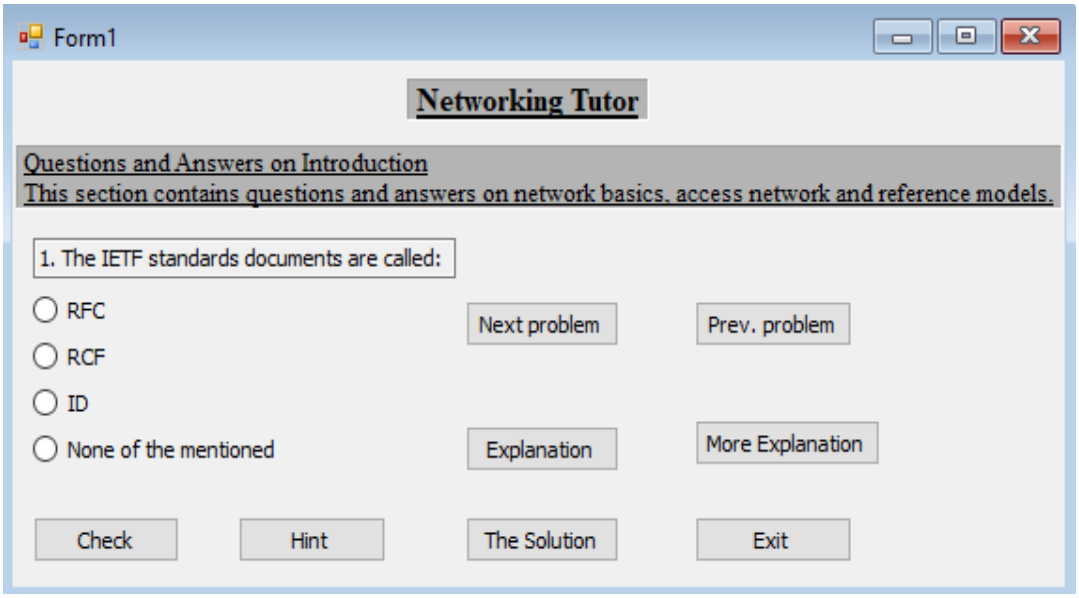


*Figure 2: Snapshot for the Networking-Tutor*

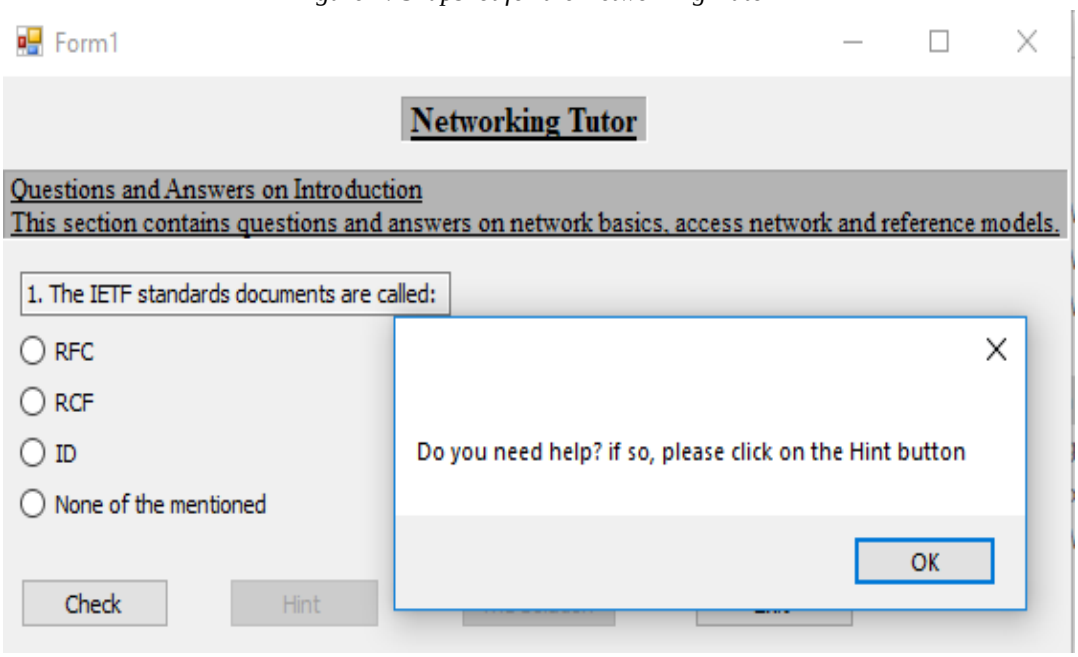


*Figure 3: Snapshot for the Networking-Tutor*

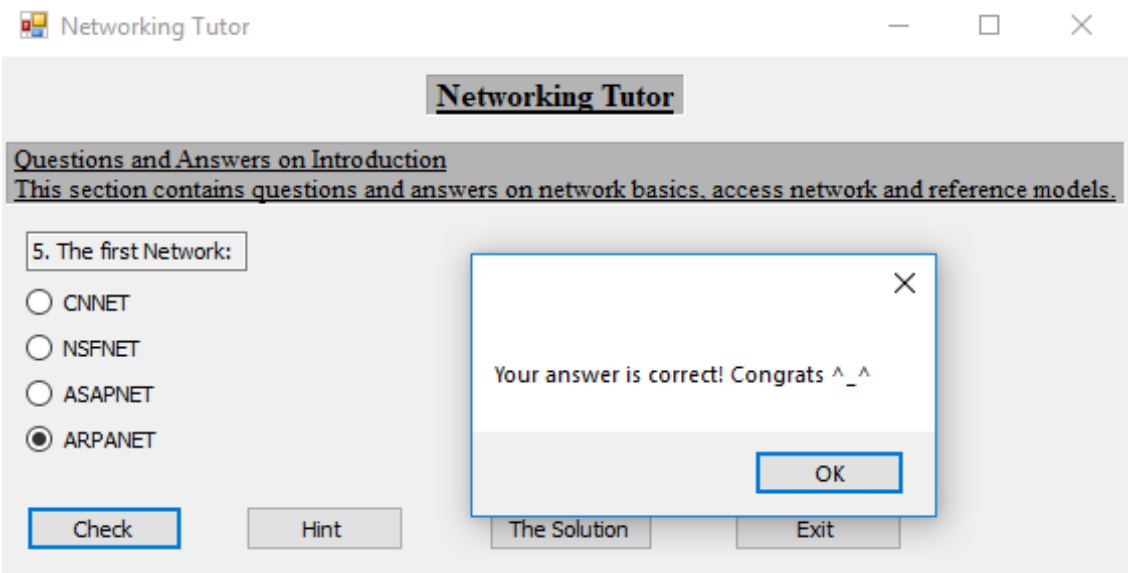


*Figure 4: Snapshot for the Networking-Tutor*

**A. Study**

This study involved senior students of a Computer Network course in the faculty of Computer Engineering Department / Collage of Engineering at Almustansiryah University in Iraq. The aim of this study was an attempt to measure the effectiveness of Networking-Tutor which was used to supplement the traditional method of leaning environment. This means that the lecturer is no longer the only focus of the learning environment. For the purpose of this study, effectiveness was assessed by student performance in the pre and post tests. Using Networking-Tutor system means that the student has far more control over his learning experience. The potential advantages held by the Networking-Tutor are: students can learn to Computer network any day, anytime and anywhere.

A group of 50 senior students taking the Computer network course was selected to participate in this study. The student sample was divided into two groups corresponding for similar background knowledge of the computer network course presented.

- The Control Group: This group who used lectures and textbox and they consist of 25 students.
- The Test Group: This group who used the Intelligent Tutoring System (Networking-Tutor) and it consists of 25 students.

**B. Hypothesis**

A comparison of the effectiveness of the Networking-Tutor method of learning against the traditional method of learning environment has been taken in the consideration in this study. The performance through the testing process of the students was defined the effectiveness of this study. Two null hypotheses have been experienced:

- There are no significant differences in performance between students in both groups in the pre-testing.
- There are no significant differences in performance between students in both groups after first post test.

**C. Testing process**

The testing process consists of two stages:

- A pre test was taken by students to assess the background knowledge of the subject matter to be presented. The purpose of this test was to enable us to divide the sample into two groups, a control group and a test group, both synchronized for background knowledge of the Computer Network course.

A post test was administered at the end of the one month training period in order to measure the student performance.

**4. Results**

The performances of students in the pre test and post test and the T-test for pre test and post tests in both groups are shown below figures which are figures 5, 6, 7, and 8.

**Pre Test:** In table 1which are illustrated below, results show that the first hypotheses can be accepted (The *t*-value is -0.12596. The *p*-value is 0.450147) showing that there is no difference in the knowledge level between the control and test groups based on pre test performance.

**Post Test:** The results of table 3 (The *t*-value is -4.73162. The *p*-value is <0.00001) show that the second hypothesis can be rejected (p<0.01) showing there is a significant difference in the performance of the two groups.

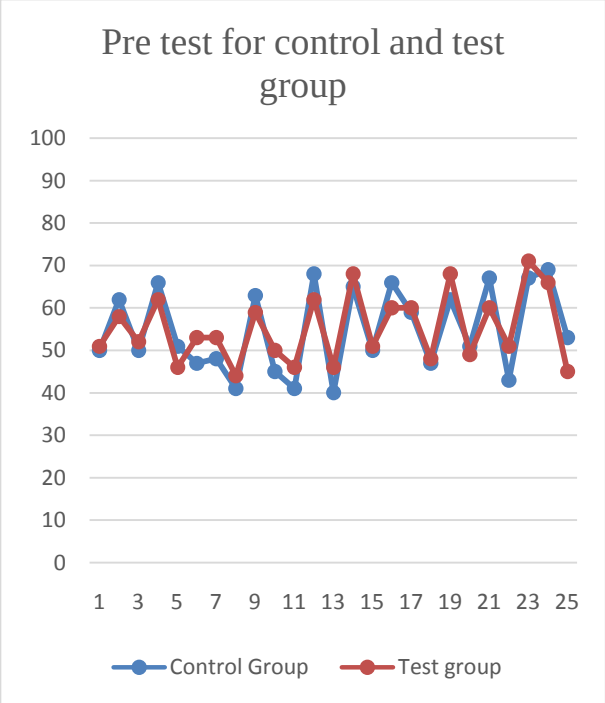


*Figure 5: Pre test for control and test group*

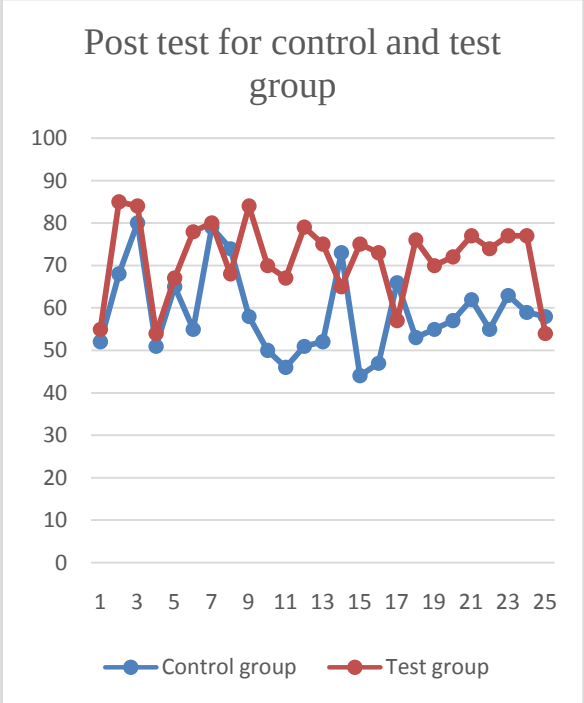


*Figure 6: Post test for control and test group*

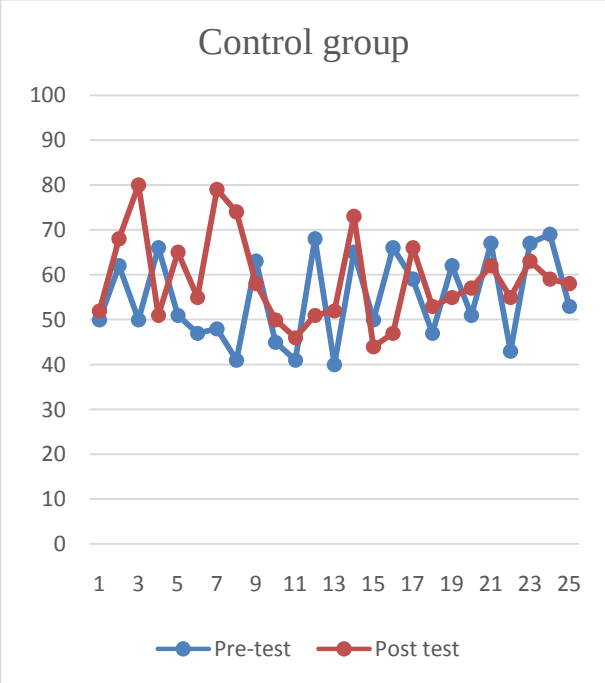


*Figure 7: Pre test and post test for control group*

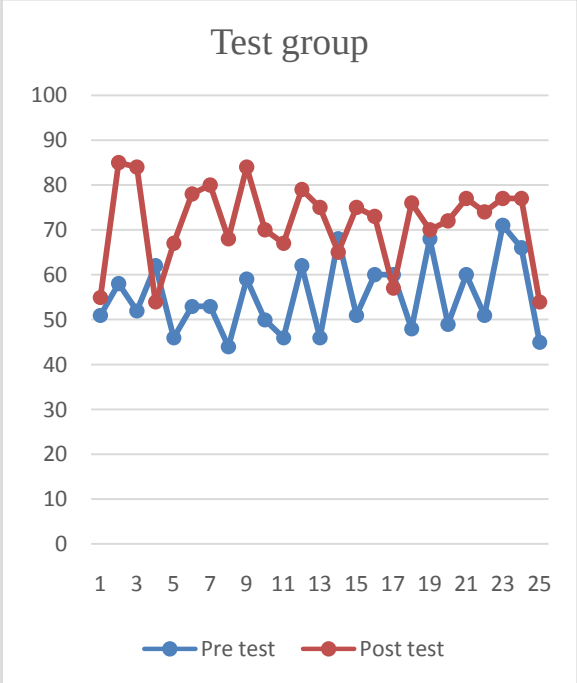


*Figure 8: Pre test and post test for test group*

**Table 1:** Pre-Test (Control Group vs. Test Group)

| Group | Mean | Standard Deviation |
|---|---|---|
| Control Group | 54.84 | 9.83 |
| Test Group using Networking tutor | 55.16 | 8.03 |

**Table 2:** Paired t-test for the Pre-Test

| | |
|---|---|
| Paired t-test | -0.12596 |
| Probability value | 0.450147 |

**Table 3:** Post-Test (Control Group vs. Test Group)

| Group | Mean | Standard Deviation |
|---|---|---|
| Control Group | 58.92 | 9.77 |
| Test Group using Networking-Tutor | 71.72 | 8.95 |

**Table 4:** Paired t-test for the Post test

| | |
|---|---|
| Paired t-test | -4.73162 |
| Probability value | 0.00001 |

## 5. Discussion

Depending on the results that we got in this paper, there were no difference between the control group and test group in the performance at the pre-test. Also, these results show that there were a big difference in the performance between these two groups at the post-test. The results proved that using the Networking-Tutor enhanced the students' performance.

The Networking-Tutor does not depend on time and location. In other words, the traditional teaching concentrate on delivering the material to students in the lecture' time regardless of the time the students need to understand these material while the Networking-Tutor is available anytime and anywhere students need it. Also, this system provide one-to-one teaching environment to the students. In other words, it assigns one teacher –the Networking Tutor- to each student.

## 6. Conclusion

In this paper, we have presented the design and the evaluation of the Networking-Tutor which is an ITS for teaching students introduction to computer network. This is one of the first experiments of using the ITS in Iraq. The results of this paper showed that there was no difference in the performance in the Pre-Test while when we used the Networking-Tutor, an improvement happened to the students who used this ITS more than others who did not use it. The results of this paper showed that Networking-Tutor is an effective learning method.

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