Computer Aided Educational Expert Technique

نظام خبير لإستخدام الكمبيوتر في التعليم

BY

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تعتبر النظم الخبيرة المعتمدة علي الذكاء الاصطناعي من أهم تطبيقات استخدام الحاسب الآلي في شتي المجالات ومنها مجال التعليم حيث تستخدم كرسائل تعليمية حديثة تتميز بعناصر الجذب للطالب مثل الشاشات الملونة والموسيقي وكذلك اعطائه الفرصة لإختيار المسار الذي يسلكه لجمع المعلومات التي يريدها بنفسه . هذا البحث يقدم احدي هذه النظم ليكون خطوة لتطوير التعليم بتكلفة بسيطة ويتغلب علي عيوب بعض الأنظمة الحالية وهو يتكون من ثلاثة أجزاء رئيسية :**الأول منها** : يختص بالتدريس حيث يشرح مكونات ودوائر الحاسب الآلي وخصوصا ذو المعالج ٨٠٣٨٦ وكذلك ٨٠٤٨٦ وايضا يتعرض هذا الجزء لملحقات الحاسب والمكونات الاضافية له .**أما الجزء الثاني** ، فيختص بتشخيص اعطال الحاسب ليساعد المستخدم علي تحديد مكان العطل والتغلب علي المشكلة بتحديد خطوات اصلاحه من خلال الحوار بين النظام والمستخدم .**والجزء الثالث** ، يتم فيه تقييم للطالب الذي استخدم النظام للتعلم حيث تضمن هذا الجزء مائة سؤال يطرح النظام منها عشرائيا عشرة أسئلة للطالب في كل مرة وبعد انتهاء الاختبار تقييم اجاباته مع جملة تعليقية امام السؤال يحدد فيها الجزء الذي يجب مراجعته اذا لم تكن اجابة الطالب صحيحة علي هذا السؤال .

تم تصميم اجزاء النظام باستخدام لغة البرولوج وهو يحتوي علي مجموعة من النوافذ وحوالي ١٥٠ شاشة ملونة لذلك فأسلوبه التعليمي جذاب ويتميز باللغة البسيطة التي يتعامل بها مع المستخدم وكتأكيد علي فعالية النظام تم تجربته علي حوالي ٢٤٠ طالبا من طلبة قسم تكنولوجيا التعليم بكلية التربية النوعية بميت غمر وتم تحليل النتائج احصائيا حيث تبين مدي تقدم التحصيل الدراسي للمجموعات التجريبية التي استخدمت النظام في التعليم عن التحصيل الدراسي للمجموعات الضابطة التي استخدمت الطرق التقليدية في التعليم .

Abstract

This paper describes a fully operational intelligent tutoring system which incorporates artificial intelligence techniques to produce a computer aided instruction system for computer configuration and troubleshooting in the domain of education. Much of its logical or inferencing capabilities are derived from human expert in conjunction with uses of simulation models.

The system also includes a high tuned structure for allowing students to communicate through a natural language dialogue and colour graphics. Although the system is extremely large, it is sufficiently fast to be exercised in a training or classroom environment.

The system goes through three phases: teaching phase, diagnostic phase, and evaluation phase. It is devolped to be a step for improving the quality of education at low cost and to overcome the problems in existing approaches. It is divided into modules, each one contains a collection of PROLOG programs and produces several windows and about 150 colour screens.

Students were considered as a model to be a major thrust in the system. Experiments had been carried out to study the effectiveness of the system and the iprovements in the academic achievement of students .

Results concluded the positive effect of the system where the experimental groups, which used the computer aided educational expert technique, had significantly greater gains than the control groups, which used traditional techniques, and had poor progress.

I-INTRODUCTION

Expert System (ES) is a new technology and at the present time is being used to construct relatively simple human-computer systems. These systems try to emulate human experts. The British Computer Society's Specialist Group on the subject has proposed a formal definition [2].

An expert system is regarded as the embodiment within a computer of a knowledge-based component, from an expert skill, in such a form that the system can offer intelligent advice or take an intelligent decision about a processing function. There are in fact four essential components of a fully fledged expert system [4]:

(1) The knowledge base.
(2) The inference engine.
(3) The consultation and explanation facilities
(4) The user interface.

In recent years, Intelligance Computer Assisted Instruction (ICAI) systems based on expert system approach are developed [6].Their contents and instructional strategies take the form of semantically related concepts and inference rules, this results in a less rigid instructional process .

The characteristics of the ICAI systems are mixed-initiative dialogue, a semantic or knowledge network and error diagnosis [3]. For the above reasons, ICAI systems can provide a mush finer degree of individual instruction and allow the learner for a great control over the instructional interaction.

In this paper we present an Educational Expert System which is considered as an application for the ICAI systems

II-EDUCATIONAL EXPERT SYSTEM (EES)

1-EES BUILDING STEPS :

As a first step for EES building, knowledge representation should be prepared. Great amount of informations are represented in facts and rules for surface representation, or in frames and semantic nets for deep representation of data structure and encoding information.

The second step is the key of any expert system, it is the inference engine which force the static knowledge base and control structure by checking the knowledge base and executing the suitable rules to achieve the decided goal. This can be done by following both forward or backward chaining.

The third step is the method of knowledge acquisition with keeping in mind that additions or modifications for knowledge may be required. It is used to assist with the development of the knowledge base and, to check incoming knowledge for possible consistencies and redundancies.

Then, the last step is the user interface which is made in the form of menu-screens where, the user can choose his option or path to call the expert module for all the informations, which are connected with his level.

Testing is also an important factor, therefore, the system is divided into modules, every one is designed and then tested by a human expert and some system users to satisfy all the requirements from the system.

2-EES FEATURES

The EES goes through three phases: teaching phase, diagnostic phase, and evaluation phase. It is developed to be a step for improving the quality of education and to overcome the disadvantages of the existing approaches. It is divided into modules, each one contains a collection of PROLOG programs and produces several windows and about 150 colour screens.

<u>i-teaching phase</u> :

In this part, the system is designed to teach computer engineering courses by describing the personal computer (hardware components and peripherals) specially the 80386 and 80486 systems.

The system displayes the block diagram of the 80386 microcomputer system motherboard and gives the user chance for moving through the motherboard and choosing any particular part for more details. Also, the system represents the 80486 microprocessor and describes the difference between the 80386 and 80486 microprocessor, the pin-out difference and the new additional pins. Also, the system represents enough information about the most common types of peripherals. The teaching method is a file system method where the information (facts, planning, apparatus details and definitions) is stored in a precostructed files, and the student can move between them and collect the information he feels is needed, within certain limits. The computer facilities such as graphics are used deppening the comprehension. Sample of screens for this part are shown in figures (1) , (2).

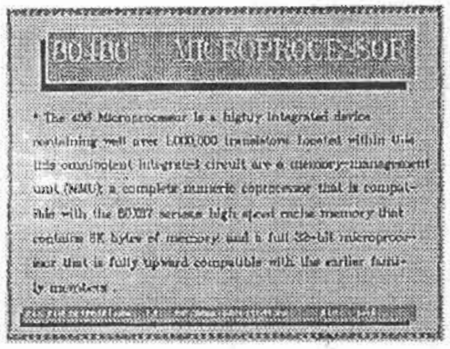


figure (1)

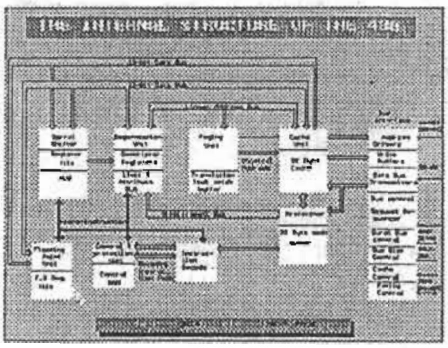


figure (2)

<u>ii-diagnostic phase</u> :

This part of the system is designed to fulfill two main objectives: the first is to explore some new dimensions for computer assisted instruction which exploit the significant increase in computational power provided by current advances in hardware technology. The second is to fulfill the need for an environment to experiment with new ways of teaching problem-solving skills, such as electronic troubleshooting, without being constrained only to pose problems having extensionally defined solution sets. We wanted to allow the student freedom in choosing the way in which he could go about solving his problem.

This part tries to advice the user to repair most of the troubleshooting that may face him in the PC set. The problem may be a simple adjustment or some cleaning or maintenance alinments and be quickly dispatched. On the other hand, the problem could have its source deep in the microcircuits. Therefore, the knowledge in this part is represented using both rule-based and frames scheme, which allow a deeper insight into underlying concepts and casual relationships,and facilities the implementation of deeper level reasoning. The problem is classified into five categories : colour and monochrome displayes, keyboard, drives and start up problems. The technique and the informations in this part is obtained from the available manuals and troubleshooting books [7]. In addition, human experts of "Computer & Control engineering dept." at Mansura Faculty of engineering, are considered as a guideline for the constraints and mounting sequence. Samples of the prepared procedures are given on screens as shown in figures (3), (4).

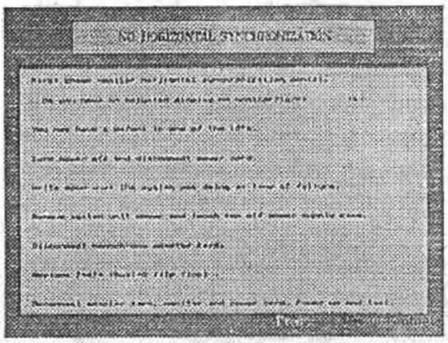


figure (3)

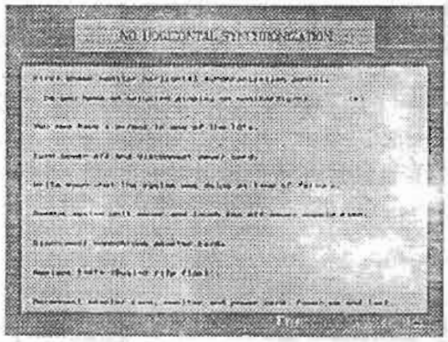


figure (4)

<u>iii- evaluation phase</u> :

In this part, the system evaluates the user and his response by giving him useful notes about the part, which he should review if he can't answer any question. Computer can support test preparation in five general ways [1]: (1) banking, (2) generation, (3) attribute banking, (4) selection, and (5) test printing. Generally the system has two major features :

a- A special item file is designed, where about hundred questions are stored in a file to include a wide range of information and to have a chance for unrepeating the same question.

b- A method of generating a large number of unique equivalent measure tests is presented using the random predicate to generate ten questions from hundred.

After the test ends, an individual evaluation for every question is given. So, the overall evaluation is achieved with a suitable comment. Also, as a negative feedback; the system gives attention about the failed question subject which must be re-studied. Samples of screens for the evaluation module are shown in figures (5), (6).

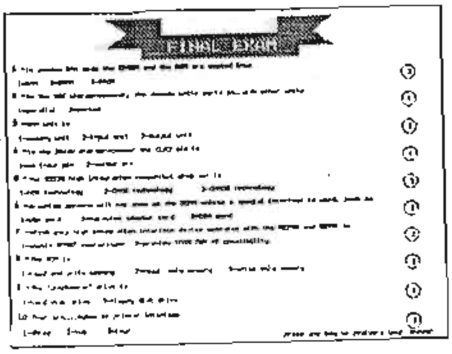


figure (5)

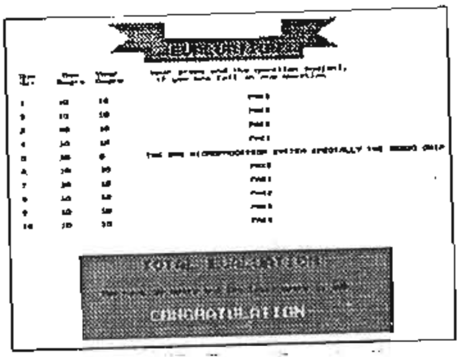


figure (6)

III-EES APPLICATIONS

1-SMALL MODEL APPLICATION

Students were considered as a model to be a major thrust in the EES. Experiments have been carried out to study the effectiveness of the EES and the improvements in the students achievement. Two groups of students are selected from the educational technology departement , MIT GHAMR Faculty of specific education. Each group is composed of 30 students. One group is considered as "experimental group" while the other is "control group". EES is applied on the experimental group in computer laboratory. The students themselves form a planning algorithm, which shows the sequences of steps that they will use in producing a satisfactory plan. Then, they apply this algorthim to collect needed information to help them. Simultaneously, the control group faces normal state through classroom and teacher. This means the traditional technique is applied.

In both groups, the students are tested to evaluate their achievement by the same test, this leads us to use the well known "stability of the test" method [9]. It can be considered as a guide for ensuring goodness of results, and can be evaluated through the reliability factor, which can be calculated by one of three methods [10]:

1- test-retest method.

2- alternate method.

3- split-half method.

The split-half method was applied to calculate the reliability factor, which must be near integer 1.0 for good test. Using a simple BASIC program, this factor is calculated for our case, and found to be 0.9.

2- ANALYSIS OF RESULTS

Statistical methods are almost required in routine testing to know whether changes in an ingradient affects the properties of the resulting material, to compare the efficiency of processes and to determine whether the results fit a suspected or postulated form. We use T test method [8] to judge whether the observed differences are due to chance only or we should suspect some real causes to be responsible and hence, considering the differnces to be statistically significant. All calculations are illustrated in tabel (1).

Tabel (1) T- test parameters for the differences between the two groups in achievement

		Control	Experimental	Pooled
Sample Statistics:	Number of Obs	30	30	60
	Average	52.223	69.775	60.9992
	Variance	242.475	180.042	211.259
	Std. Deviation	15.5716	13.418	14.5347
	Median	53.315	70	60

Conf. Interval For Diff. In Means: 95 percent

(Equal Vars.) Sample 1 - Sample 2 -25.0662 -10.0385 58 D. F.

(Unequal Vars.) Sample 1 - Sample 2 -25.0697 -10.035 56.8 D. F.

Conf. Interval for Ratio Of Variances: 0 percent

Sample 1 / Sample 2

Hypothesis Test for H0: Diff = 0 Computed t statistics = -4.67706

Vs Alt: NE Sig. Level = 1.78491E-5

at Alpha = 0.05 *so reject H0.*

The barchart for the numerical data of the control and experimental groups are shown in figures 7 and 8 . These figures indicate the expected results for this new technique and its positive effect on the experimental group while, it has significantly greater gains than the cotrol group which has poor progress.

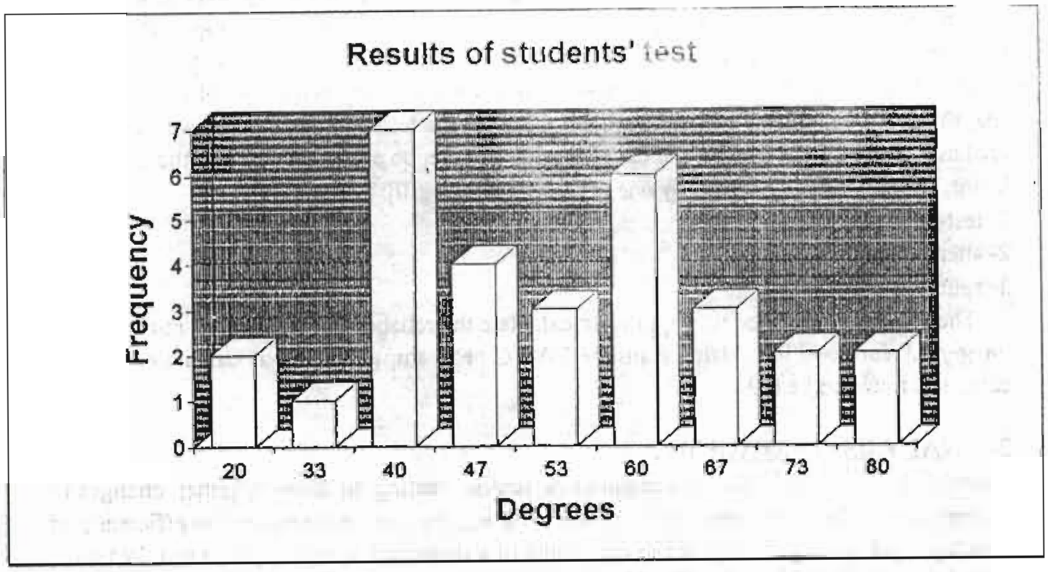


Figure (7) Barchart for the control group students' results

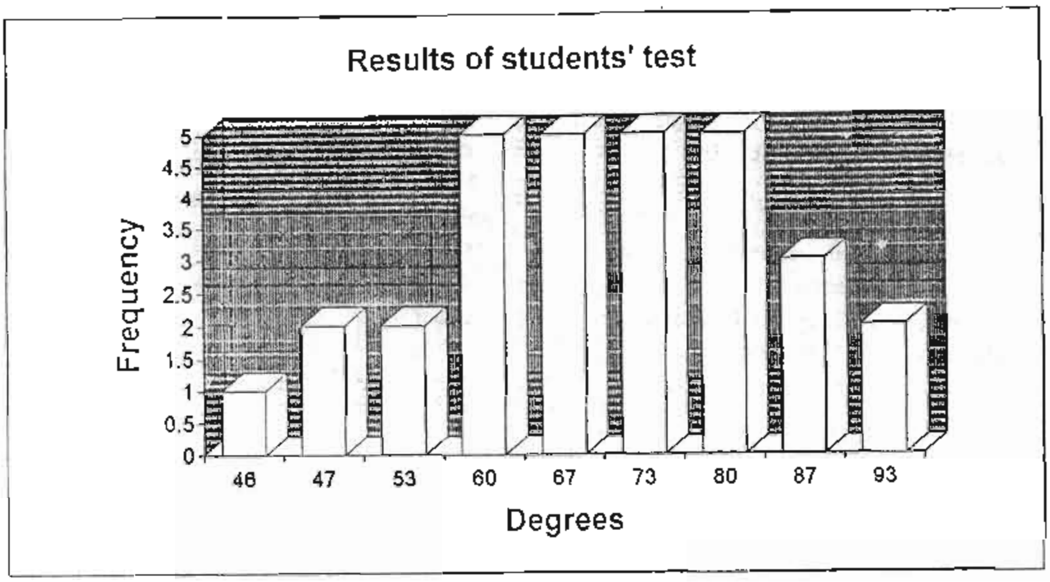


Figure (8) Barchart for the experimental group students' results

3- GENERALIZATION FOR LARGER MODEL

We consider another large scale model to study the effectiveness of increasing the sample size. The students test model is divided into three groups, one experimental group and two control groups, each group consists of 60 students. Same statistical methods mentioned befor are applied. All calculations are illustrated in tabels (2)& (3). The barchart for the numerical data of the three groups are shown in figures 9,10&11 which agree with the previous concluded comments for the small size model.

Tabel (2) T- test parameters for the differences between the experimental group and the first control group in achievement

		Experimental	Control	Pooled
Sample Statistics:	Number of Obs	60	60	120
	Average	67.3333	57	62.1667
	Variance	409.718	512.881	461.299
	Std. Deviation	20.2415	22.6469	21.4779
	Median	70	60	60

Conf. Interval For Diff. In Means: 95 percent

(Equal Vars.)	Sample 1 - Sample 2	2.56634 18.1003	118 D.F.
(Unequal Vars.)	Sample 1 - Sample 2	2.56534 18.1013	116.5 D. F.

Conf. Interval for Ratio Of Variances: 0 percent
Sample 1 / Sample 2

Hypothesis Test for H0: Diff = 0 Computed t statistics = 2.63518
Vs Alt: NE Sig. Level = 9.53853E-3
at Alpha = 0.05 *so reject H0*

Tabel (3) T- test parameters for the differences between the experimental group and the second control group in achievement

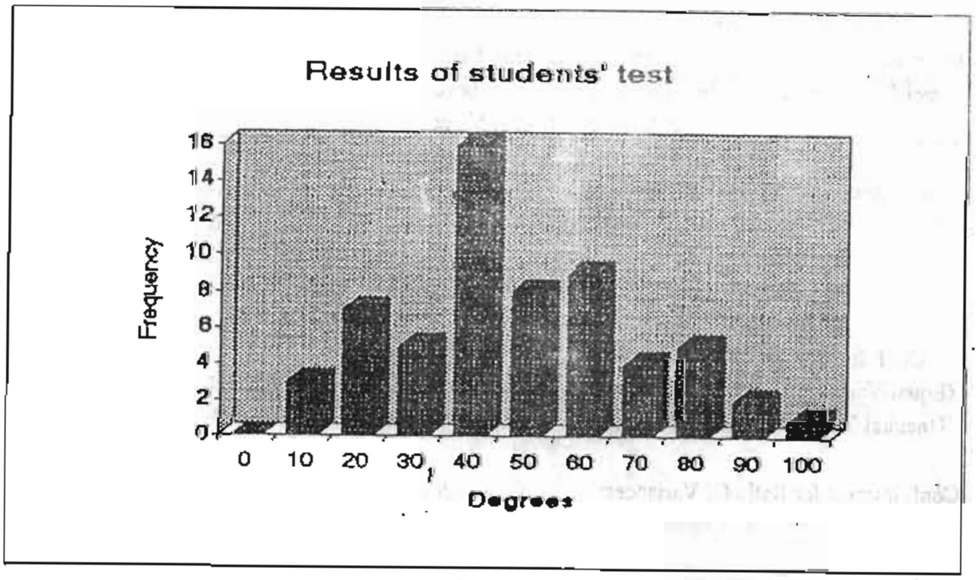
	Experimental	Control	Pooled
Sample Statistics: Number of Obs	60	60	120
Average	67.3333	47.667	57.5
Variance	409.718	458.87	434.294
Std. Deviation	20.2415	21.4213	20.8397
Median	70	40	60

Conf. Interval For Diff. In Means: 95 percent

(Equal Vars.)	Sample 1 - Sample 2	12.1305 27.2029	118 D.F.
(Unequal Vars.)	Sample 1 - Sample 2	12.1302 27.2031	117.6D. F.

Conf. Interval for Ratio Of Variances: 0 percent
Sample 1 / Sample 2

Hypothesis Test for H0: Diff = 0 Computed t statistics 5.16892
Vs Alt: NE Sig. Level 9.71525E-7
at Alpha = 0.05 *so reject H0*



Figue (9) Barchart for the first control group students' results

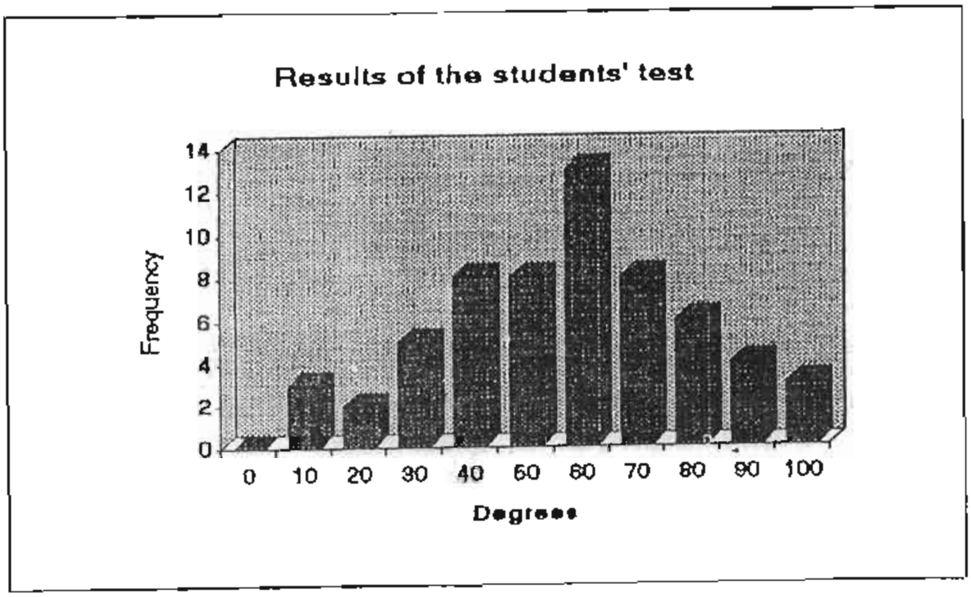


Figure (10) Barchart for the second control group students' results

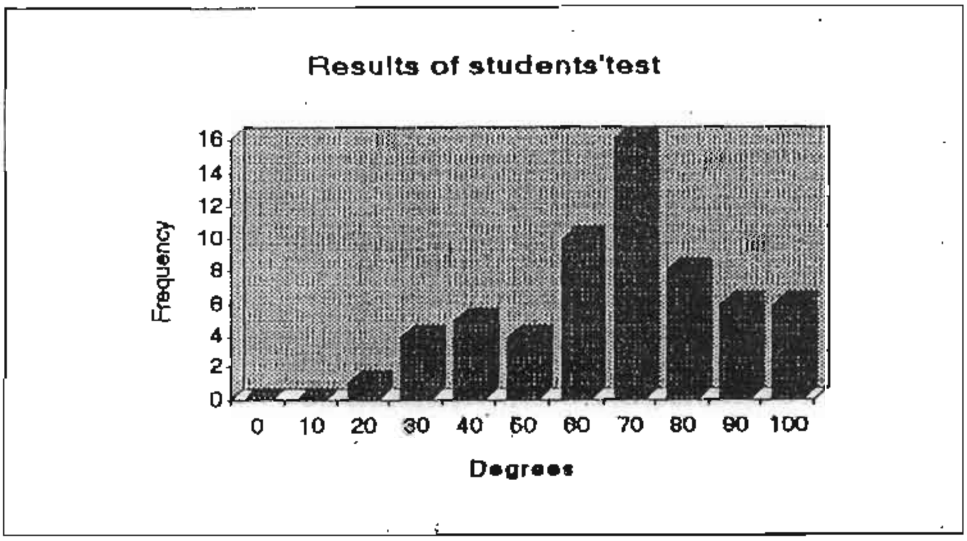


Figure (11) Barchart for the experimental group students' results

CONCLUSION

This paper presnets an Educational Expert System (EES) as an application of expert techniques in the domain of education. It goes through three phases:teaching phase, diagnostic phase, and evaluation phase. EES is developed to be a step for improving the quality of education at low cost and to overcome the disadvantages of existing approaches. Experiments have been carried out to study the effectiveness of the EES and the improvements in achievement of 240 students. The analysis of results conclude the positive effect of the system.

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