J. King Saud Univ., Vol. 11, *Comp. & Info. Sci.*, pp. 85-104 (A.H. 1419/1999)

A Computing Curriculum for Technical High Schools in the Kingdom of Saudi Arabia

Mansour M. Al-Sulaiman
Computer Engineering Department, College of Computer & Information Sciences,
King Saud University
P.O. Box 51178, Riyadh 11543, Saudi Arabia

(Received 30 March 1998; accepted for publication 01 June 1998)

Abstract. Technical high schools provide graduates with the practical skills to enter directly into the job market. Computer education is very important for these graduates. To prepare the school graduates for the twenty first century, the technical high schools in the Kingdom of Saudi Arabia made computer education a separate course in all three years of technical high schools. This will give students experience with the computer tools that will be an inevitable part of their lives and work. The purpose of this paper is to describe a curriculum for technical high schools in the Kingdom of Saudi Arabia (KSA). The paper also includes a justification for the proposed courses and conditions for successful implementation of the proposed curriculum.

1. Introduction

The technical high schools in the Kingdom of Saudi Arabia play an important role for the development of the country. The government provides extensive support to them in order to produce technically qualified manpower with practical experience in state of the art techniques. Recently the support has become more extensive to satisfy the demand for these graduates to replace foreign labor in the country. This speeded up the process of modernizing technical high schools. One aspect of this modernization is the move to make computer education compulsory in all three years of technical high schools. In this paper we outline a computing curriculum for technical high schools in KSA.

We begin by introducing the organization that supervises technical education in KSA. Though the proposed curriculum is intended for industrial technical high schools, it was written with the intention of applying it in other technical high schools as well.

The computing curriculum in high schools is more established and has received greater attention than the computing curriculum in technical high schools. Hence we describe different models of the curriculum in high schools. To gain a comprehensive view of this curriculum we look at it from different angles and viewpoints. We then outline our proposed curriculum for the three years of technical high schools. Tables showing details of the courses and class distribution are included.

For a successful implementation of the proposal, certain conditions have to be met. We present these conditions. Finally, we give our conclusion.

2. The Technical High School System

Technical education in KSA is the responsibility of General Organization of Technical Education and Vocational Training (GOTEVT). GOTEVT supervises three types of technical education:

- Technical Colleges: Accept students after completing high school. Graduates are awarded a Diploma or a Bachelor of Technology degree.
- Technical Schools: Supervises technical high schools
- Vocational Training: Provides vocational training of different duration. Graduates receive necessary skills in a chosen technical area. No conditions are required to enroll.

The technical high schools have different specialization. The important specialization is:

- Industrial
- Commercial
- Agricultural

The proposed computer curriculum is intended for industrial high schools, but it may also be adopted for other specialization, except the commercial high schools whose program have been completely revised including computer education. The industrial high schools have the following departments:

- Electronics
- Electrical technology
- Mechanics
- Vehicular technology
- Metal technology

Some of these departments have more than one track. For example, the electronics department has three tracks. Students in each department receive practical knowledge in their specialization and extensive hands-on training. The time allotted for specialized material is equally divided between theory and practice/lab. The students

also study general sciences and humanities courses such as, physics, chemistry, Arabic and English languages. Table 1 gives the distribution of courses and their number of classes for the electronics department-electronic communications track. We note that the classes distribution breaks down into:

Specialization	65 %
Science	17.5 %
Humanities	10 %
English Language	7.5 %

Other departments or tracks have similar distribution. We can see from Table 1 that the computer courses have been allocated two classes per week for all three years. The task given to this author was to suggest the curriculum for these courses. The author was also asked to propose a curriculum for a new track in the electronic department. This new track is called computer technology. The graduates of this track can work as PC technicians. The curriculum for this track is being developed.

Department : Electronics **Track: Electronic Communications**

Table 1. Course distribution for the electronics department (electronic communications track)

Subject	First year (Classes/Week)	Second year (Classes/Week)	Third year (Classes/Week)
General subjects			
Religion	2	2	1
Arabic language	1	1	-
English	3	3	3
Mathematics	3	3	2
Physics	1	1	1
Chemistry	1	1	1
Computer	2	2	2
Physical education	1	1	-
Specialized material			
Fundamentals of electricity & electronics	5	-	-
Technical computing	2	2	-
Technical drawing	2	2	-
Analog electronics	-	3	-
Digital electronics	-	2	-
Analog and digital communication systems	-	-	5
Electronic communication circuits	-	-	2
Technology of microwave and antenna	-	-	3
Industrial economics	-	-	2
Lab and workshop	17	17	18
Total	40	40	40

3. Teaching Computer Science in High Schools

Computer Science is a new field of knowledge that has developed rapidly over the past 10 years [1 - 5]. The technology, research, and applications of computing are accelerating and it is very difficult to keep pace with. New subfields are emerging rapidly. The foundation of the computing field itself is getting affected by such changes [6 – 7]. As a result the curriculum in computer science and engineering forces constant evolutionary pressure to integrate new developments [6]. Making a curriculum for this field is a challenging and an ongoing task and needs continuous updating. In the following, we look into computer science in high schools from different angles.

3.1 Major societies' recommendations

Major computer societies defined the computer science field [4] and suggested a curriculum for it at the university level [1 – 5]. They also suggested a curriculum for high schools. The latest of such recommendations for high schools are presented in [8] and [9]. These two recommendations can be summarized as below:

1. The ACM-1985 recommendation [8]:

The recommendation defined the content of four courses to be given in high schools. The courses are:

1 Introduction to Computer Science I (a full year course)
2 Introduction to Computer Science II (a full year course)
3 Introduction to High-level Computer Language (a half-year course)
4 Applications and Implications of Computers (a half-year course)

Courses 1 and 2 were intended to prepare the student for college. Hence these courses are not relevant to our report. The choice between courses 3 and 4 were left to the school.

2. The ACM-1993 recommendation [9]:

The main points in the recommendation related to our work are:

(a) The study of the computer science subject should concentrate on the fundamental scientific principles and concepts of the field.
(b) The current study of computers in high schools is characterized by either the use of computers as a tool for other disciplines or programming. Neither of these is computer science although both comprises aspects of the discipline.
(c) The proposed course is a one-year computer science course. It should serve all students in the same way that an introductory biology, chemistry and physics do.
(d) The course can serve as a minimal requirement in itself or as a prerequisite for advanced placement computer science.

(e) The recommendation was based on previous ACM and IEEE related reports.
(f) The recommendation identified five areas as main areas, namely, Algorithms, Programming Languages, Operating Systems and User Support, Computer Architecture, and Social, Ethical, and Professional Context. In each of these areas the material is divided into core, recommended, and optional topics. The report also adds two areas to choose one topic from. These are Application and Additional Areas.
(g) No fixed model is given to use, instead different models were generally presented. The model that may be near to our goal is application model but we will not cover all its areas as shown later.

We went into great length of summarizing the last ACM recommendations because we think it is important for the reader to be familiar with it before we give our proposal.

3.2 Computer education in high schools in U.S.A.

ACM report for computer science in high school [9] and the ACM/IEEE task force report [5] found that there were varieties of educational models. Hence, the reports gave what every curriculum should have but left the final shape open to different forms. Consequently, different forms of computer science in high schools can be found. Two examples of such varieties were presented by Dillon [10] and Doerr [11]. Whereas Dillon [10] incorporates AI into high school computer curriculum enabling the students to design expert systems and integrate machine vision with robotics, Doerr [11] includes courses on computational complexity and makes available supercomputers to high school students. These two references do not represent the norm. We mentioned them just to show how wide the spectrum is.

Two recent papers commented on the situation of computer science teaching in high schools. Tucker [6] states that "No coherent secondary-school curriculum is widely implemented for the general population." Wegner and Doyle [12] state that "There is much ferment and some confusion at all levels concerning the teaching of computing, with no agreement on how it should be taught in high schools, at the advanced placement level, in first courses, or in junior-senior courses".

A recent visit to many high school WEB sites confirmed that this is the case till now. It also showed that the application course is normally the required computer course while programming is optional.

3.3 Computer science in high schools in other countries

The author conducted numerous computer searches on "Computer Science in High School". Papers and reports published on this topic are very few and, except the ACM recommendations, they contain little helpful details. References for Computer Science in high schools, in countries other than USA are few [13 - 17]. Chion and Wu [13] talk about a new computer curriculum guideline for Taiwan junior high school that

was announced in 1994 and will be nationally implemented in 1998. The content outline given in this reference is similar to our recommendation, except for some differences. The paper lists 12 areas that have to be covered including: computer ethics, programming languages, and trends of computer evolution. For us, computer ethics will be covered in another course about industrial relations and ethics. Programming language is not relevant to our curriculum as we will see later. Trends of computer evolution is a general information topic that we rather use its time for some practical material or hands-on experience. We covered the application part more heavily than this recommendation.

Pusiri [14] showed that trends in computer education in Thailand are toward learning computer application rather than programming. Gupta [15] has a similar view. Pusiri [14] also showed that all the countries surveyed are facing the same problem of not having enough computers for instructional use and lack of qualified personnel. This is a point we will discuss later. Curricula presented in [13-15] include general computer awareness, applications, and programming.

Gal-Ezer, *et al.* [17] introduce a computing curriculum for high schools in Israel. It has a philosophy similar to ACM-1993 recommendation in that the study of the computer subject should concentrate on the fundamental scientific principles and concepts of the field. The reference accomplishes this in a more extensive curriculum. It consist of five modules, namely, fundamentals 1 and 2, software design, second paradigm, applications, and theory. It emphasizes the notion of an algorithmic problem and algorithm as a solution thereof. The more general notion of a system and the accompanying principles of modularization and abstraction are also discussed. The ACM-1993 program amounts to a one year 120 hours CS orientation course, whereas the program of this reference can reach 450 hours, taught over three years.

3.4 Computer science in high schools in Saudi Arabia

The first exposure of students to computers in public schools in the Kingdom of Saudi Arabia is in high schools. Private schools start teaching computers from first grade but with no national guidelines. Computers at home are relatively not common. But this is changing with more homes acquiring PC's, due to their attractive price, power, and the availability of Arabic educational software tailored to the country's needs.

The contents of the computer courses in high schools in Saudi Arabia (two classes per week) can be summarized as follows:

First year

General Introduction to Computers and their Components
DOS
WINDOWS
Computer Graphics

Word Processing

Second year
Data Representation
Spreadsheet
Information Systems and New Administration
Data Bases

Third year
The Programming Language BASIC
It is interesting to notice that the second year did not include hands-on experiments.
This curriculum is being revised, but it was the one implemented at the time of our proposal.

3.5 Computer science in technical high schools

We mentioned before that the references about computer science in high schools were few. The references about computer science in technical high schools were even rare [18-20] and not helpful to our work. We could not find any society recommendations for this topic. Gloeckner [18] talks about the experience of four Colorado high schools in a technology awareness program. Computer was one of the technologies and was used as a tool to experiment with many of the other technologies. Vocational education program course standard was suggested [19] for exploratory courses, practical courses, and job preparatory programs offered at the secondary and post secondary level as part of Florida's diversified education program. A two-year computer technology and maintenance program was described [20]. Courses were scheduled to be offered in Fall 1985. This reference might be suitable for historic comparison with a program of computer technology in industrial technical high schools in Saudi Arabia that was proposed and will be reported later in a forthcoming paper.

From the above discussion it is clear that the references on computers in technical high schools were not satisfactory to our work. So we relied more on references on computer in high schools taking into account the differences between the technical and regular high schools as we will discuss in the following section.

4. The Proposed Computer Curriculum in Technical High Schools

To arrive at our proposal we not only searched the literatures as we presented in the previous section, but also looked at the contents of all courses of technical high schools, and sought the opinions of many computer science educators. Based on all this, we developed our proposal. Before we present the proposal we would like to mention the following:

4.1 Important considerations for proposing the curriculum

1. The goal of high school science courses is to teach the students the fundamental concepts of the fields of science and prepare the students to continue their study in the university in any science field that they will choose. The goal of technical high school is to equip the students with the necessary knowledge and experience to be able to directly work in their area of specialization after graduation. Hence what may be suitable for high school students in order to give them the solid background in science, may not be needed by technical high school students. In short, there is a big difference between teaching high school students and teaching technical high school students.
2. From the search that we conducted it was clear that the computer applications course was offered in almost all curricula while the programming language course was an option.
3. The ACM 1993-curriculum is not suitable for technical high schools. Only computer technology related areas are common between it and our proposal.
4. Each country puts its own recommendations based on its educational system and the professional societies' recommendations.
5. College graduates and employers demand that the curriculum be practical and prepare them for jobs [21]. The same is demanded by technical high school graduates.
6. Learning how to use a programming language is of little use to technical high school graduates. Their work and work environment do not need the use of a programming language. Although it is mentioned by some [8] mentions that the goal of the programming course is not to teach programming but to teach how to use computers to solve problems, we think that technical high school graduates can use computers to their benefit without learning programming. A similar conclusion was reached for the computer science education in high schools [13, 15]. For example Chion and Wu [13] state that "Programming is not a required skill for junior high school students". It is interesting to note that Valengen [22] found that there was no difference in problem solving ability between those who studied programming and those who did not.

4.2 The proposed curriculum

The curriculum was proposed in Jananuary 1997. It consists of a compulsory course for each of the three years. Each semester runs for fourteen weeks. Since the course was allocated 2 classes per week it will be taught in 28 classes per semester (56 classes per year). The proposed curriculum is shown in Tables (2-5). It can be summarized as follows:

First year: A general introduction to computer with some hands-on experience on the operating system (MS Windows), some small basic applications (accessories), and computer network.

Table 2. Outline for the computer course on first year in technical high schools

Subject	No. of classes
Introduction to computers	
Importance of computers and its role in life	2
Examples of computer usage	1
Types of computers	1
Components of the computer system	
a) Hardware	1
Primary components	
Peripherals	
b) Software	
Operational software	1
Application software	1
Basic components of the computer	
CPU	1
Input devices: Keyboard, Mouse	1
Output device: Screen, Printer	1
Storage devices: Floppy, Hard and Optical disks	2
Computer peripherals	
Scanner	1
Plotter	
Modem	
Network card	
Operational software	
DOS	4
Basics of electronic files	2
Basics of windows environment	2
Office desktop	1
Working with windows (Open, Close, Move, Resize, Maximize, Minimize)	2
File management	3
Control panel	3
Printer management	1
Application software	
Clock	1
Calculator	1
Diary	1
Paint	4
Write	4
Use of clipboard	2
Multimedia	
Introduction	1
Running multimedia applications	2
Adjusting sound	
Hypertext	1
Computer networks	
Introduction	1
Sharing resources	2
Browsing network neighborhood	1
E-Mail	2
Internet and Intranet	2
Total	**56**

Table 3. Outline for the computer course on second year in technical high schools

First Semester

Subject	No. of classes
Part I: Word processing	
Introduction and basic concepts	2
Text entry and updating	3
File manipulation	2
Document formatting	3
Tools	1
Printing	1
Case Study	3
Part II: Computer graphics	
Introduction and basic concepts	2
Drawing tools	3
Text tools	1
Formatting the graph	2
File manipulation	1
Printing	1
Case study	3

Second Semester

Subject	No. of classes
Part I: Spreadsheets	
Introduction	2
Data entry and editing	2
File manipulation	1
Table formatting and printing	2
Functions	3
Graphics	2
Case Study	3
Part II: Introduction to databases	
Introduction and basic concepts	2
Development of DB	2
Adding, deleting, and updating records	2
Query	2
Reports and printing	2
Case study	3
Total	**56**

Electronic Circuit Simulation

Table 4. Outline for first semester computer course for the electronics department computer drawing

Subject	No. of classes
Introduction	2
What is EWB?	
Design cycle	
Overview of EWB5 user interface	3
EWB menus	
File, Edit, Circuit, Analysis, Window, and Help	
EWB parts bin toolbar	
EWB circuit toolbar	
The circuit window	
The description window	
Status line	
ON/OFF power switch	
Building and testing analog circuit	3
Placing components	
Wiring components	
Labeling components	
Setting values for components	
Testing the circuit	
Using analog instruments	2
Oscilloscope	
Function generator	
Bode plotter	
Building a digital circuit	3
Understanding the TTL Library	
Placing, Wiring, and Labeling the components	
Testing the circuit	
Using digital instruments	2
Logic probe	
Logic converter	
Word generator	
Logic analyzer	
Circuit simulation	4
The student is to implement and test a medium scale mixed circuit (i.e. containing digital and analog devices).	
Exporting circuits to a PCB layout package	6
SPICE netlist	
Hot to export a circuit for use in a layout package	
Using your circuit in a PCB layout package	
Troubleshooting for exporting to a PCB layout package	
Project	3
Total	**28**

Computer Drawing

Table 5. Outline for the first semester computer course for the electrical, mechanical, vehicular technology, and metal technology department depts

Subject	No. of classes
Introduction to autocad	
Introduction	1
Understanding autocad interface	
Accessing commands	1
Using a toolbar	
Using a menu	
Using the command line	
Switching from dialog box to command line	
Opening existing drawings	1
Saving drawings	
Exiting autocad	
Correcting mistakes	
Refreshing the screen display	
Organizing the project	1
Conforming to standards	
Setting up new drawings	
Co-ordinate systems	1
Cartesian system	
Polar system	
Direct distance entry	
Creating objects	
Drawing lines	2
Lines, Polylines, Multilines, Polygons and Freehand	
Drawing curved objects	2
Splines, Circles, Arcs, Ellipses and Donuts	
Creating point objects	1
Creating solid-filled areas	
Hatching areas	1
Drawing with precision	1
Adjusting snap and grid alignment	
Ortho mode	
Snapping	
Controlling the drawing display	1
Zoom and Pan	
Editing methods	2
Naming objects	
Selecting objects	
Editing linetypes	
Editing colors	

Table 5. (Continued)

Subject	No. of classes
Copying, Moving, Erasing, Resizing, and Exploding objects	2
Editing Polylines, Multilines and Splines	1
Chamfering and Filleting objects	1
Using layers and system variables	2
Layers	
System variables	
Adding text to drawings	1
Dimensioning and tolerancing	3
Working with blocks	2
Defining blocks	
Inserting blocks	
Layout and ploting	1
Total	**28**

Second year: Computer Applications. This include

- Word processing
- Drawing
- Spreadsheet
- Data base

Third year: The use of a specialized software that suites the needs of each individual department or track.

The rational for the first and second year content is clear and goes with the norm in high schools. The time allotted for them is more than in other curricula. In the sequel, we give a brief justification for each topic.

First year

General introduction: This gives the minimum required knowledge for a student in the information age.

Operating system: The basics of the current operating system is given.

Basic applications: We use the applications that come with the operating system to let the students use the PC effectively. This will give them confidence and break the fear barrier that they might have for PC's.

Multimedia: It is one of the new technologies that is becoming very essential for computer users.

Computer Networks and Internet: Necessary for a graduate in this information age where the notion "The network is the computer" is becoming a reality.

It should be noted that when the author was asked to make the proposal, a book for first year was already being used. This book was intended for a new curriculum in commercial high schools. The book used Windows 3.1. Windows 95 was just coming at the time of the book authoring. Since the book was already used in industrial high schools and it covered the majority of our proposal, we made our proposal with no reference to a specific operating system but with an inclination to Windows 3.1 versus Window 95. This book is now being updated for Windows 95 (see Table 6).

Operational Software

Table 6. Modification to the first year program replace windows 3.1 by windows 95

Subject	No. of classes
Basics of windows environment	2
Office Desktop	1
Starting and stopping windows	1
Start menu	3
Working with windows (Open, Close, Move, Resize, Maximize, Minimize)	2
Basic of electronic files	2
Explorer	3
Control panel	3
Printer management	1
Total	**18**

Second year

Word processing: Writing letters or reports
Graphics: Necessary for any student of technical high school. The students actually study drawing extensively.
Spreadsheet : The graduate performs many spreadsheet applications in his work.
Database: After graduation every specialization has special tailored database programs. This will give the students the basics of databases.

Third year

The rational for the third year content is that the information and experience in the first two years on computer and its applications is enough and need only two years for the level required. Giving a programming language was excluded as mentioned before. The best choice is therefore to give the student experience on some of the software tools in his specialization that he might use in his future work.

To choose the tools we looked into the curriculum of each department. We also interviewed teachers and GOTEVT supervisors from each department. The proposed courses for each department are as follows:

Electronics department
First Semester : An Electronic Circuit Design and Simulation Package
The Electronics Work Bench (EWB) was the chosen package for the first semester because of its excellent graphical user interface. The Electronics Work Bench has a PCB package that may be used for the second semester.

Electrical, mechanical, vehicular technology and metal technology departments
First Semester : Computer Drawing
The package chosen is Autocad. Autosketch was considered because of its ease of use. However, we chose Autocad because it is the standard package in the industry.

The second semester : As we mentioned before, the 3rd year computer content should be specialized programs for each department or track. After looking into each department curriculum and following consultation with the teachers and supervisors, we arrived at the proposal for the first semester. The general shape for second semester will be more diversified. Each department has to participate in selecting a suitable course. For some of the departments the desired program is almost selected while for others the topic itself is still being reviewed. The following is a preliminary sneak preview description of the expected proposal.

1) Electronics department: PCB for all tracks. EWB-PCB is a likely candidate.
2) Vehicular technology: The student already use specialized workshop computers for car diagnostics. Some packages are available for simulating this or to be used as a CAI system. Database System is for warehouse of spare parts.
3) Metal technology-plant installation Technology Track: Simulation software packages are available in some work environment. Similar programs available to students are being evaluated. Database system for warehouse of components.
4) Metal technology – Steel Construction Track: Programs for statistics, Database System for warehouse of components.
5) Electrical Technology: Specialized programs for electrical design, Database System for warehouse of electrical components.
6) Mechanics: Measurement and evaluation by PC, Programs for mechanical design, Database system for warehouse of components.

4.3 Software package, specify or do not specify?

In proposing a curriculum for computer, there is always a difficult task of trying to make the content independent of specific hardware and software brands in order to avoid obsolescence. This is becoming more and more difficult because some hardware and software are becoming the defacto standard. A PC with an Intel CPU is the standard in hardware, while Microsoft operating system (MS Windows) is the standard in software. So the proposal should be based on these standards. As for the application software it is written independent of a certain brand, although Microsoft tools are also becoming the standard. Moreover, learning a specific application package is sometimes a main requirement. For instance instead of training the student on any computer

drawing package we want him to learn Autocad specifically. This will also help the student in getting a job.

Another related question is should the text book be written for a specific software and a specific version or should it be independent? Some educators argue that the text book should be divided into two parts corresponding to theory and the practical application. We believe that in general this is not applicable for technical high schools where the objective is to equip students with maximum attainable skills and minimum theoretical knowledge. This was our approach for technical high schools in Saudi Arabia.

5. Guidelines for the Successful Implementation of the Proposal

5.1 Book authoring: GOTEVT has a booklet on book authoring [23]. We add the following guidelines:

(a) The book will be written in Arabic but the terminology should be given in both Arabic and English. Many translations exist for some terminologies. All books will adhere to only one set of terminology translations.

(b) Examples are preferably given from the materials the student studies in other courses. For third year, this is almost mandatory since the book will use examples the theory of which is explained in classes of other courses. For example, in electronic circuit simulation we will take a circuit from his subject book and let him simulate it. The book will not explain how the circuit works because this is assumed to be covered in the relevant electronics course.

(c) It is recommended to include a disk for examples or demos. For example, the AutoCAD book will have a CD containing example drawings and exercises.

5.2 Curriculum and book updating: It is understood that a curriculum in computing may have to be modified every 2-3 years and the books have to be revised to go with latest version of software.

5.3 Instructor preparation: Highly qualified and well trained teachers are crucial to the success of any study program. This is more critical for the computing field which is in constant evolution [24]. The instructors for the first two years of the proposed program are graduates from computing departments or (unfortunately sometimes) interested instructors from other fields who have been trained for computer teaching. The instructors for the third year have to be from the technical instructors of each department. Though it is preferable to make a special program to train the instructors for the new curriculum, this was not possible for instructors of all years. Since the majority of the topics of first two years can be covered by private institutions spread all over the Kingdom of Saudi Arabia, it was left to the schools to arrange for trainings. The topics for the third year may be available in two or three cities in KSA, so a special program has to be designed for the teachers. This program includes introduction to computers

and the operating systems. Following this, they are trained on the specialized software (e.g. EWB or AutoCad).

As the computer field continues to evolve and new versions of the software are being introduced the instructors should be always kept updated about such developments. Training courses for instructors should be given whenever needed.

5.4 Labs: These courses are based on hands on experience. Hence, having the right labs is mandatory. To help GOTEVT in this matter the author visited some technical high schools. A report was written indicating that the technical high school labs are equipped with PC's but the majority of those PCs need to be upgraded and their number should be increased. The report also recommended having a projector connected to the instructor PC in every lab. As software becomes more powerful, it needs more powerful PCs'. So software and hardware have to be upgraded. This may coincide with writing new books.

5.5 Assessment: Assessment has an important role in education. The course contents, text books style, adherence to the guidelines, instructors preparation and effectiveness, and labs preparations and updating are very important factors that have to be continuously assessed. GOTEVT has supervisors in each technical department and there is a separate entity for curriculum development and research. It also has consultants from universities and the industry, still the assessment task is enormous and needs more resources.

The first year courses have been implemented for one year. At the end of the year questionnaires were sent to all participating technical high schools. The response is being evaluated. One item in the response was agreed upon by the majority of the instructors, that is to replace Windows 3.1 by Windows 95. This is being carried out in the new edition of the book. Table 6 shows the modification to the first year program by replacing Windows 3.1 with Windows 95. The second year course is being taught for the first time. After being offered for a year it will be assessed for contents, book, support ---- etc.

5.6 Resource centers: Currently no such center is available, but it is a necessity that such a center should be implemented soon. These centers should provide help to instructors and schools. Resources include technical help, books, software, demos, CD's, CAI software for students or instructors --- etc. Some of the supervisors at GOTEVT have part of this, but a formal center or centers should be established.

6. Conclusion

Compared to university curriculum the high school computing curriculum is more challenging because the university curriculum is managed by the computing departments

and the computer societies. Tailoring the high school curriculum to fit the need of technical high schools is also a challenging task. In this paper we presented a proposal for a computing curriculum in technical high schools in the Kingdom of Saudi Arabia. We benefited from looking into current computer science curricula in high schools and the recommendations of professional societies. However, we choose what we think will be the best for technical high schools in general and industrial technical high schools in particular.

The first year of this proposal has been implemented and early indications show that it was successful. The second year is in progress and books for the third year are being authored. The proposed curriculum improved the job prospects of the graduates by equipping them with the necessary skills for the computer era.

In this paper we presented guidelines for successful implementation of the proposal. These guidelines are being followed. An example of the real desire to follow these guidelines is that the book of the first year is being rewritten taking into consideration new changes in the field and the instructors feedback.

Acknowledgement. The author wishes to acknowledge the support provided by GOTEVT in preparing this proposal. He also wishes to acknowledge many scholars within the College of Computer and Information Sciences, King Saud University, in GOTEVT, and in other computer establishments. He is indebted for their valuable time and excellent suggestions.

References

[1] The 1983 Model Program in Computer Science & Engineering, Technical Report 932, *Computer Society of the IEEE*, 1983.

[2] Koffman, E., Stemple, D. and Wardle, C. "Recommended Curriculum for CS1: 1984." *Communications of the ACM*, (Oct.1984), 998-1001.

[3] Koffman, E., Stemple, D. and Wandle, C. "Recommended Curriculum for CS2: 1984." *Communications of the ACM*, (Aug. 1984), 815-818.

[4] Denning, P., Comer, D., Gries, D., Mulder, M., Tucker, A., Turner, A. and Young, P. "Computing as a Discipline." *Communications of the ACM*, (Jan.1989), 9 – 23.

[5] Tucker, A. B. *et al*, A Summary of ACM/IEEE-CS Joing Curriculum Task Force Report. Computing Curricula 1991. *Communications of the ACM*, (June 1991), 69-84.

[6] Tucker, A.B. *et al*, "Strategic Directions in Computer Science Education." *ACM Computing Surveys*, 28, No.4, (Dec. 1996), 836-845.

[7] Goldweber, M. and Impagliazzo, J. "Historical Perspective on the Computing Curriculum." *ITiCSE* '97 *Working Group Reports and Supplemental Proceedings*, 94-111.

[8] Roger, J., Achberger, F., Aiken, R., Arch, J., Haney, M., Lawson, J., Lemke, C., Swanson, T. and Tumolo, S. "Computer Science in Secondary Schools: Course Content." *Communications of the ACM*, (March 1985), 270-274.

[9] Task Force of the Pre-college Committee of the Education Board of the ACM, ACM Model High School Computer Science Curriculum, *Communications of the ACM*, (May 1993), 87-90.

[10] Dillon,R.W. "Artificial Intelligence and the High School Computer Curriculum." *Computer Teacher*, V21 n1, (Aug-Sept. 1993), 22-23,

[11] Doerr, Helen M. *SuperQuest: A Historical Retrospective on a Computational Science Program for Secondary School.* Annual American Educational Research Association, San Francisco., CA. (April 18, 1995).

[12] Wegner, P. and Doyle, J. *Strategic Directions in Computing Research, ACM Computing Surveys.* (Dec. 1996), 565-574.

[13] Chion, G. and Wu, C. "A Computer Curriculum Guideline for Junior High Schools in Taiwan: Its Impacts and Issues." *National Educational Computing Conference*, Minneapolis, (1996), 80-87.

[14] Pusiri, Tanit. *An Examination of Microcomputers in Education in Thailand.* Boston University, EdD, (Sept. 1992).

[15] Gupta, R.P. "School Level Computer Education (Class Project)." In: *Computer Education in India*: *Past, Present and Future.*" Benerjee, ULK. (Ed.). The Institution of Electronics and Telecommunication Engineers, (1996), 73-85.

[16] Tengku Shahdan and Tengku Shahrom. "The Implementation of a National Computer Education Project in Secondary Schools in Malaysia: Teachers' Perceptions." University of Georgia, PhD, (1994).

[17] Gal-Ezer, J., Beeri, G., Harel, D. and Yehudai, A. "A High School Program in Computer Science." *Computer*, (Oct. 1995), 73-80.

[18] Gloeckner, W. "Selected Colorado Technology Education Programs." The American Vocational Association Convention, Cincinnati, OH, (December 1990).

[19] *Diversified Education, Vocational Education Program Courses Standards.* Florida State Dept. of Education, Product Distribution, Tallahasseo, FL, (July 1997).

[20] *Computer Technology and Maintenance Curriculum, Manchester Community Coll., Conn., Final Report.* Connecticut State Dept. of Education, Hartford, Bureau of Vocational Services, (10 June, 1985).

[21] Denning, P. "Educating a New Engineer." *Communication of the ACM Journal*, 35, No. 12, (December 1992).

[22] Vanlengen, Craig A. "Effect of Computer Programming Instruction on the Problem Solving Ability of College-level Introductory Computer Students." *Northern Arizona University*, EdD, (1988).

[23] *Book Authoring Guidelines.* GOTEVT, Riyadh, The Kingdom of Saudi Arabia.

[24] Cal-Ezer, J. "Computer Science Teacher's Certification Program." *Computers Education*, 25, No.3, (1995), 163-168.

منهج حاسب للمدارس الثانوية الفنية في المملكة العربية السعودية

منصور محمد السليمان

قسم هندسة الحاسب، كلية علوم الحاسب والمعلومات، جامعة الملك سعود،
ص.ب ٥١١٧٨، الرياض ١١٥٤٣، المملكة العربية السعودية

(قدّم للنشر في ١٩٩٨/٣/٣٠م؛ وقبل للنشر في ١٩٩٨/٦/١م)

ملخص البحث . تزود الثانويات الفنية خريجيها بمهارات عملية تؤهلهم للدخول مباشرة في سوق العمل، ويعد تعلم الحاسب من العلوم الضرورية لهؤلاء الخريجين، ولاعداد هؤلاء الخريجين للقرن الواحد والعشرين قامت الثانويات الفنية بإدراج مادة خاصة للحاسب في جميع المستويات. هذه المادة ستعطي الطلبة الخبرة في أدوات الحاسب التي ستصبح من أحد ضروریاتهم العملية والحياتية. تهدف هذه الورقة إلى وصف منهج للحاسب للثانويات الفنية في المملكة العربية السعودية. كما تحتوي الورقة على تبرير للمقررات المقترحة والشروط المطلوبة لنجاح تطبيق هذا المقرر.