Overview of Tutorial Systems based on Information Technology

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ABSTRACT

This paper is a part of the authors' research during the development of a project entitled "Tutorial System for Work Safety and Health in SMEs According to the European Union Directives". This project started from the idea that, among the software products that are domain oriented the work safety and health domain is moderately covered. This thing is even more relevant when it refers to organizations like small and middle enterprises (SMEs) that do not have the possibility for thorough training, for long periods and by leaving the work place. Likewise, such organizations don't afford using sophisticated management systems for work security and health. So, it appeared the necessity for a tutorial system with a very friendly user interface, that will allow the non-professional users to use the system without special problems like the necessity to learn a programming language or to follow a thorough computer science course.

For the development of such a system, the project included a study of various types of tutorial systems based on information technology.

The paper presents an overview of the main categories of learning and testing software, with several examples of software implementations.

Categories and Subject Descriptors

K.3.1 Computer Uses in Education (computer-assisted instruction)

General Terms

Design

Keywords

Tutorial systems

1. INTRODUCTION

Most specialists consider that there is no doubt about the positive impact of computer based solutions for learning and training purposes, but the challenge is to better utilize their characteristics, by which they differ from other learning media: interactivity, precision of operations, the ability to provide various, dynamic presentations and, mostly, the ability to interact consistently and in a personalized manner with each learner.

If the first solutions in computer aided learning were focused mostly on learning by testing of knowledge, the later advancements, in the form of complex software applications, offer active knowledge building, promote reflection, free the learner from routine tasks and stimulate the intellectual activity of adults, similarly to the challenges of the work environment.

The learning process must be reshaped by contributions of actual cognitive psychology advances. The trainers must adopt a different way of thinking, of learning task conception, with less focus on routine intellectual tasks.

The education is influenced by the technological evolutions on one side, and by the requirements of the society, on the other hand. The mission of educational research is to anticipate the social tendencies and to design and experiment feasible solutions, appropriate to the changes ahead.

Based on the studies conducted internationally, there are several conclusions related to the efficiency of using educational software, like:

- almost all research results demonstrate the advantages of computer based learning compared to other methods;
- the learning time is reduced;

- the attitude towards computers as learning tools is improving;
- the use of computers is more present in sciences than in foreign language training;
- exercise is, in computer aided learning, efficient for developing primary skills, while tutorial systems are more efficient in developing superior intellectual skills;
- computer aided learning is more efficient as complementary tool, rather than a replacement for traditional learning;
- the slow learners and those with learning gaps benefit more;
- the computer–based learning strategies are efficiently used at lower levels of educations.

The concept of computer aided learning, and of course educational software, may be viewed from the following perspectives:

- in a wide sense, computer aided learning is the set of educational situations where information and communication technology is significantly present. Under the name of educational / teaching software we find a large variety of electronic (multimedia) materials, developed to simplify the learning process: maps, dictionaries, encyclopedia, video clips, presentations in different formats, e-books, tests, tutorials, simulations, software for skills development, learning games etc. Computers and multimedia are used as teaching / learning support, evaluation, or communication as learning support.

- in a restricted sense, computer aided learning is identified with the concept of e-learning – a type of distance education based on structured teaching / learning experience, organized by an institution that provides materials sequentially and logically through a communication medium, to be assimilated by learners in a personal manner. The mediation is realized by information and communication technologies – especially the Internet. The Internet is the medium for both the distribution of learning materials, as well as for the communication between the actors in the learning process. Functional in the higher and adult / continuing education fields, the Internet-based e-learning replicates and adapts the components of the traditional face-to-face learning: planning, content and method, interaction, support and evaluation.

2. TUTORIAL AND TESTING SYSTEMS

There is an unanimously agreed classification of software applications by the specific didactical function they provide in a learning process: exercise, interactive presentation of knowledge, presentation of models of real systems and simulation, testing of knowledge, development of abilities and skills by game-like activities.

2.1. Tutorial Systems

Tutorial systems are classified in general and domain specific tutorial systems.

2.1.1. General tutorial systems
Can be grouped as Dictionary or Glossary of Terms Tutorial Systems, Help-type systems and tutorial systems designed to support teaching activities.

2.1.1.A: Dictionary or Glossary of Terms Tutorial Systems
In this category we can mention the "PsychDef" product. It was conceived by the psychologist J.M. Rathbun in order to provide a glossary of scientific terms and concepts, and has the following characteristics:

- it contains a database of over 250 terms from behavioral sciences. Each term is associated with a definition and an example.
- it allows the user to view the definition, hear the pronounciation and read mentions a concrete situation where the term is used.
- it contains a testing facility, based on multiple-choice from similar terms
- the user interface is basic, but sufficient for the program's needs
- the software runs on 386-based or newer computers.

Help-Type learning systems

These are components of more complex software applications, which offer information about the different functions, commands and operations that the user may perform in the applications.

Generally, help systems appear inside the software product, as a specific command menu; in some cases they are found as distinct applications, installed together with the main application.

Their purpose is to assist the user in cases when more information about using the application is needed, or when specific error situations occur. The may contain more or less distinct tutorial facilities.

In the following, an original classification of help-type systems, based on their tutorial facilities, is given:

- *Text type help* – Presents information only as text. It displays the explanation of the specific option or term chosen by the user in a list. A distinct category are the "read-me" files which, independently of help content, provide late breaking information about eventually undocumented characteristics of a program .

- *Hyper link help* – hyperlinks are connections that allow the navigation to other text pages. This kind of help allows the user that , as he or she is he reading the help information, to display the definition of selected terms by clicking the term.

- *Help with related topics* – offers the possibility to access information related to the data presented on the main screen. This type of help represents a superior development of the hypertext systems. For a specific term the user is able, in order to enhance his knowledge, to access related terms.

- *" What's this " type* – offers local assistance concerning buttons and commands on screen, in order to explain symbols, icons or operations that the user needs. These type of help is shown by clicking in a specific symbol. then using the mouse pointer with the

symbol for clicking the interesting item, which shows the help information .

- *off-line tutorial help* – Contains tutorial fragments that can be accessed without an internet connection. These help systems, besides offering direct assistance for specific terms, containe also short tutorials to guide the user, step by step, in realizing basic operations (like drawing a shape) with the program. These types of help contains text facilities, as well as local help facilities, what's this"" type facilities, and tutorials that can be off-line, embedded in the program, without the need for internet access.
- *Help With online tutorials* – Contains sections of tutorials that can be accessed on an internet connection.
- *Do it yourself type help* – This type of help is the most complex in its class and allows the program to supervise, guide and correct the user's actions in case of errors, Assisting the user during learning of the program's functions.

Analyzing then described help systems, the following characteristics were apparent :

- they are either external or internal components of other software applications ;
- Together with the user's manuals they support the assistance and learning of users related to the specific application;
- They are only related to using the software and do not provide content for general or specific skills besides that .
- They can be considered as localized training systems with an extremely focused specialization.
- They are limited to presenting specific terms or , in the best case , step by step assistance in executing simple operations.
- They contain limited amounts of specific information; the information is structured at knowledge level only in exceptional cases.
- They do not offer the possibility to replicate and test specific actions;
- They do not offer evaluation possibilities;
- The only provide a minimum of information ; The user must find additional information either in specific libraries or user manuals ;
- They do not require supplemental resources additionally to the host program.

2.1.1.B Learning systems for didactical use

These are learning software applications are designed that , from elementary cognitive operations, Like reading and writing , and up To superior levels, To allow the user to build and consolidate abilities, either general Ones Or the very specific (Piano playing Psychology or Neurosciences.

Considering learners by their age, One can observe that for lower ages (up to twelve years) there are general learning software applications; As subjects get older , The software applications Become more specialized, According to the skills that the subjects want to develop .

A special mention must be made About Then development of skills for senior persons . In this regard for the alphabetization of adult persons, For example, The software applications contain structures adapted specifically for this age group, In order to provide an appropriate framework for developing these skills.

Software systems for elementary learning – aim to facilitate The learning off abilities like writing, Reading arithmetic calculus geography, botanics, Astronomy etc. As it was emphasized before, the software applications Which address higher age groups Contained customized structures, adapted to this target . In the following, two such a to products are briefly presented .

- The TestBuddy program (www.testbuddy.com) offers direct access To the SkillsTutor learning engine, which is the nationally adopted Basic education on-line system in U. S. A. and Canada.
  SkillsTutor is designed for children from 6 years of age, as well as adults, who wish to develop basic abilities:

  - writing – on an appropriate level for being able to produce simple documents, CVs and requests;
  - reading and understanding, including a special modules for the mentally disabled;
  - arithmetics – basic calculations;
  - speech – coherent verbal expression;
  - workplace abilities for adults.
  SkillsTutor is a complex program, which first assesses the starting level of the learner, facilitating direct access to the next relevant modules. After using SkillsTutor , there was a 30% improvement in the respective skills.

  The program is locally installed and accessed on PC and Mac computers, and offers acces to the central engine which runs on USBE (U.S. Board For Education)'s servers.
- The **Master of Universe** program (www.m.of.unive.com) is dedicated to the assimilation of elementary astronomy knowledge. It contains a large number of animations, charts and drawings that explain visually the presented topics. It runs on both PC and Mac-based computers.

2.1.2. Domain-specific software applications

Aceste sisteme pot fi împărțite în mai multe categorii dintre care:

- **Produse software de instruire în domeniul economic**

  Astfel de produse software urmăresc în special instruirea în domeniul financiar-contabil cât și în privința completării formularelor corespunzătoare pentru taxe. Un exemplu de produs care face parte din această categorie îl reprezintă produsul *Financial Accounting Tutor.* Acesta a fost conceput pentru instruirea specialiștilor de nivel mediu și superior și folosește în mod extensiv grafica pentru a ilustra diverse aspecte ale domeniului financiar, plecând de la exemple simple și ușor inteligibile.

  Analiza acestui gen de produse software relevă mai multe aspecte și anume:

These systems can be categorized as follows:

- **Learning software for economics**

These products are designed mostly for learning in the accounting domain, as well as for assistance in filling tax forms. One example in this category is the product Financial Accounting Tutor. It is aiming to offer learning content for average and advanced level professionals, making extensive use of graphics to illustrate different aspects of the financial field, based on simple examples.

Analyzing this kind of software applications, the following aspects can be observed:

- o intuitive graphical user interface, based on buttons for program navigation, loading modules, saving different pages etc.;
- o images are used to graphically support the understanding of information content;
- o they are targeted to a specialized audience, which is continually developing, and where the demand for training exceeds the supply;
- o they require average computer resources with respect to hardware and software.

- **Learning software for mathematics**

These applications are thought to provide assimilation of mathematical knowledge for various levels of expertise and various age groups. From the variety of existing products, two of them are briefly presented – one related to medium level and the other to an advanced level. **Algebra** is an introduction in algebra knowledge, including an interactive equation solving facility. It runs on Windows-based platforms and is targeted for a 12-15 years old population. **Transmath** is a hypermedia learning environment developed in Britain and addressed to first-year engineering students, in order to develop their mathematical skills through an individualized system, adaptable to the understanding level of each student. The program is realized using the Mathematica environment, specially designed for higher level mathematics applications. The program is a development of the early CAL (Computer Aided Learning), a tutorial program for matrix theory developed at the Leeds University, based on Mathematica Notebooks for PC/Windows.

- **Learning software for physics**

The existing products offer physics knowledge on different levels and age groups, and are elaborated by various developers. The program "Physics – Interactive Lectures and Study 1.0 and 2.0", realized by Teachingmouse (www.teachingmouse.com). The software is an additional tools in the learning process and allows the teacher or learner an easy interaction. Each program runs in its own window, with no need for navigation between screens. Different parameters can be modified, so that the users can see the effect of their changes in the analyzed systems, with an instant animated response. The software is developed using Visual Basic and runs on Windows 95/98 PCs. Its main advantage is the facility of interactive study of physical phenomena; also the graphical interface uses advanced features, with animation support, contributing to a high-end result.

- Learning software for musical training

This is a very specialized category of software applications, that, beside theoretical knowledge, must offer also ways to develop the musical abilities. Three software products of this category are further presented. **Ear Training Software** was developed by music professor David Bradfield, and is aiming to develop specific abilities for musical hearing. It was initially developed for university students. Specific hardware (sound-card) is used by the software to produce specific sounds, which must be recognized and reproduced by the students. software has an intuitive user interface and is developed for Windows PCs.

MusicMastery is a complex program for music learning, developing musinc composing abilities for both amateurs and professionals. It uses open methods which allow the trainer to demonstrate the most important aspects of music theory to the students. For example, the study of melody is structured in the topics tonality and rhythm. Also, the creation process is divided in two components: rhythm creation and melody creation. On Mac platforms, the product integrates with MIDI Manager, OMS and QuickTime, and on PCs with a MIDI device.

Musicianship Basics is a program that offers the following fundamental abilities: reading notes, identification of notes with piano keys, recognizing rhythm and melody, recognition of scales, modes and intervals, note names and durations. The program also corrects the errors of students. It is aimed for the beginner and is less complex than the previous one.

2.2. Computer Aided Testing

Computer aided testing, also named electronic or on-line evaluation or web-based evaluation, is a common term used to describe the use of computers in the evaluation process of students. It involves the computer based grading, analysis of results and feedback of examination.

The advantages of computer aided testing are:

- Frequent feedback
- Better motivation of learners
- Flexible content (audio and video)
- Easy administration of test content

A software application that offers question and answers based testing can replace a human examinator. The human examinator must design the test questions and answers. Multiple answers must be offered for choice, with one ore more correct answers. The students must mark the correct answers, which are then evaluated by the computer.

Characteristics of the testing software:

- the questions can be chosen from different chapters and/or disciplines
- questions are randomly selected in the test
- the answer options are randomly listed
- the user may or may not come back to a question
- the available time is managed by the software
- the test results can be saved and evaluated, and feedback on wrong answers may be given.

3. CONCLUSION

From the above-presented facts it is clear that there is a high diversity of software products available for supporting learning activities, from basic to post graduate levels and related to different areas of knowledge.

In this paper, several such programs were presented, belonging to the various types and knowledge areas. There are many other similar products, which were not available for study and therefore not included in this study.

The specifics of tutorial systems leads to a possible classification as:

- development tools for tutorial systems, also called authorware applications;
- actual tutorial systems, at general or specialized level.

Regarding the knowledge areas covered by specialized tutorial applications, the health and safety domain is not sufficiently covered. This is even more problematic for small and medium-sized enterprises, which do not have resources for specialized training on longer term, which also would involve the unavailability of personnel for daily duties.

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