CIT FOR SELF-DRIVEN INTEREST-BASED ADAPTIVE LEARNING (SDIBAL) IN ELECTRICAL ENGINEERING

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Abstract

In this paper we discuss the use of communication and information technology (CIT) in a self-driven interest-based adaptive learning (SDIBAL) environment. The paper is, to some extent, focused on engineering studies, even though the concepts that we discuss can be easily adapted to other subjects. The main goals of this work are to 1) explain the SDIBAL concept, 2) illustrate how CIT can be used to implement a working SDIBAL system, 3) show how SDIBAL can provide excellent matching between the qualities of the graduates and those required by available jobs. We have preferred not to dig deeply into any particularities of the proposed system. This is because we believe the very idea of SDIBAL can be quite debatable among the different parties that are involved in educational processes. We believe the brief idea we present in this paper will help in steering the directions of future research on the issue towards the most influential areas of using SDIBAL as a successful educational system.

Keywords

Communication and information technology; adaptive learning; self-driven learning; interest-based learning

1. INTRODUCTION

The process of learning involves the most essential activities in the life of a human being. It is true that a human can perform many tasks by the very nature of his/her creation. However, many other tasks are possible to perform only after some sort of learning. Some learning activities are short-term and are based on instantaneous needs, while others can be long-term (they can actually extend for the whole life time of a person), and are based on fundamental needs and survival necessities. Sources of learning start from the immediate surrounding (family and home), to the neighborhood, street and school, to the work environment, all the way to the global scene and beyond it.

In fact, a person learns something because 1) he/she needs it, 2) he/she likes it, or 3) he/she happens to be at the right time and place to learn it. For example, learning how and what to eat is something we need in order to be able to live, while learning how to play football is something that we can do if we like playing football. In contrast, we learn a lot of things about a foreign city or country because we happen to visit it, or we happen to watch a TV documentary about it.

As far as education is concerned, learning is part of an academic and/or a training process. In this paper, we choose to deal with academics, while stressing that most of the arguments that we make are applicable to training (even if often with some modifications). The traditional way of going about education is via three main constituents: 1) the learner (commonly known as the student), 2) the educator (commonly known as the teacher or the professor) and 3) the physical environment (commonly a school, college or university). With the accelerated technological

developments that the world has witnessed over the past few decades, the education process has undergone substantial changes. Many of these changes are due to the fast and wide spreading of communication and information technology (CIT) into the daily lives of most people in most places in this world.

It is beyond the scope of this paper to attempt a full account of the use of CIT in education. Interested readers are referred to the numerous articles and books that have already been published in this active area, e.g., [1]-[5]. Instead, we devote the following sections to the topics of self-driven learning, interest-based learning and adaptive learning. We define these terms, then show how a combination of them can lead to a very useful system for engineering education.

2. WHAT IS SDIBAL?

Adaptive learning (AL) involves the adjustment of one or more characteristics of the learning environment [6]. Adaptation can be applied to any or all of the following: 1) content and forms of presentation of learning materials to the learner, 2) order and pace of learning actions, following the progress rate of the learner, 3) optimization of system actions to achieve the best possible learning outcomes [6]. The last type of adaptation can, for example, take the form of controlling the difficulty levels of the learning materials, adding exercises, quizzes and exams, or pointing the learner to supplementary learning materials.

Self-driven interest-based learning (SDIBL) is used in this paper to describe the situation where the learner sets the course of study according to what a certain profession requires. Needless to say, the profession and the chosen topics are of significant interest to the learner. For example, the learner may be willing to become an electrical engineer who works at the customer service department of a company. Typically, this position does not require deep knowledge in many areas of electrical engineering (like signal analysis, transforms, linear algebra, fields and Maxwell's equations, and many other areas). In contrast, the position requires some other skills that are not comprehensively covered by electrical engineering curricula (like communication skills, legal and financial matters, marketing, and so on).

SDIBAL is the type of learning where AL is combined with SDIBL. We claim that this combination (SDIBAL) can help in producing professionals with non-traditional qualifications, who can work in non-traditional professions. An example has just been given in the previous paragraph. We also claim that SDIBAL can achieve the following benefits:

1. The new professions that SDIBAL makes available reduce financial burdens on employers. This is because with SDIBAL, the employers can hire fewer people whose qualifications are more fit to the job requirements. This can be vital for smaller employers and startups.
2. Increasing the productivity. This is because the new professionals are sufficiently armed with the knowledge and skills that are required by their professions. Additionally, and because of the interest-based factor, the professionals are more satisfied with and more confident about the way they perform their jobs.
3. As far as engineering educational institutions are concerned, SDIBAL can link them more tightly and in better ways to the job market. This makes the education provided by these institutions more useful to their communities. It also has a multiplicative effect on the creativity of both the educators and the learners.

4. As far as the engineering profession is concerned, the pace of technological advancement, which is provided mostly by engineering, will be accelerated; because of the many new directions of work experience and scientific research that will be created.

3. How CIT Works for SDIBAL

As the CIT domain of platforms, applications, services and devices has grown too wide to survey in a single article like this one, we choose a few indicative items from this domain, and illustrate how they can be utilized to achieve SDIBAL.

3.A. Internet and Web Programming

The internet has changed almost every possible aspect of people's life, ranging from simple personal daily activities to large-scale organization-level, or even country-level, tasks. This includes communication and information exchange activities, socializing, financial transactions, business and marketing, media and TV, and so on. Education cannot be, and has not been, an exception. Countless education-related platforms, portals, websites, applications, tools and services have appeared with varying degrees of complexity, success and usefulness.

A major enabler of the vast development and fast penetration of the internet is the field of web programming. Sites and pages on the internet have developed from passive interfaces that display text and images to full-fledged active applications, with rich, dynamic, responsive and interactive content. This is seen, as far as this article is concerned, as the corner stone of SDIBAL. Web programming is required to allow the learner to control the course of study and to choose what topics to study in depth, by availing controllable parameters and options that the learner can modify at will. Web programming is also required to facilitate the functions of adaptive learning, by integrating into the learning system features that adapt the presentation and contents so that the learning outcomes are optimized.

3.B. Computers and Software

To use the internet and to run the SDIBAL system, the learner needs a computing device (desktop or laptop, for example) that is equipped with suitable software packages. The computer itself (i.e., the hardware) has to meet certain minimum criteria to be able to handle the required functionality. Among these are requirements on the processor, the memory, the networking hardware, the display and other output devices, the keyboard and other input devices, and so on. The requirements on software can be too many to list here, but they certainly include networking software, web browsing software, simulation packages (especially for engineering study programs), word processors, and so on.

3.C. Mobile Devices and Applications

Mobile devices (e.g., smart phone and tablets) and their applications have essentially similar requirements to those of computers and their software (see Section 3.B. above). However, mobile devices enjoy the unique added feature of mobility. They can provide access to the SDIBAL system any time anywhere. At the same time, mobile computing has grown to the level where it provides means of every possible way of communication or information exchange. Interestingly enough, the mobile computing environment is user-friendly, and it needs virtually no previous computing experience on the part of the user. Actually, many people are nowadays more comfortable with using a mobile device than with using a laptop or desktop computer.

4. ROLE OF INSTITUTIONS

Institutions host (even if mostly virtually) the learners and the education process as a whole, prepare and administer the study programs, and award the degrees. Hosting implies the existence (along with all needed installation, maintenance and management) of the education physical infrastructure, including rooms, offices, laboratories, libraries and so on. Preparing and administering the study programs is a comprehensive, adaptive and continuous process. Comprehensive; means including as many topics as possible, with carefully chosen topic branching options. Web hosting, web programming, content management and administration of the SDIBAL system have to be provided. Adaptive and continuous; means that the institutions have to integrate into their SDIBAL systems the needed features to make the education materials continuously adjustable, expandable and as up-to-date as possible. The SDIBAL administrators at an institution need to provide the course designers with efficient and easy to use tools to update their courses and topics. Awarding the degrees involves: 1) setting the degree requirements, 2) obtaining national and international accreditation of the study programs, 3) integration of quality control measures and 4) all other traditional requirements like systems for running student admissions, student grades, financial proceedings and so on.

Apart from the above, the institutions have to be actively linked to the job market. They have to be always aware of the professions in demand. Joint committees with members from the institutions and from the job market, who meet regularly, can simplify this task, and provide the following additional gains: 1) study plans can be updated according to the job market demands whenever there is need for this, 2) graduates of the institutions are more guaranteed to find jobs reasonably quickly after graduation and 3) there will be more occasions when job market leaders are convinced to sponsor and support the educational programs at the institutions. The last advantage is of paramount importance to engineering programs; because such programs have strong practical training components that require costly laboratories, equipment and materials.

5. EXAMPLE SDIBAL SYSTEM

In the below, we assume the following hierarchy: university, school, department, program. A university has several schools, each of which can have several departments. A department can offer a number of degree programs. We limit our discussion to degree programs at the first (bachelors) university education level. A student studying a degree program is granted the degree upon fulfillment of the study plan requirements of the program.

In the example we are considering here, we assume that the requirements of a degree program in electrical engineering (EE) consist of 200 credit hour units (CHUs), and that they are categorized as follows:

- University Requirements in CHUs

University Compulsory	20	These are fixed, and should be studied by all university students.
University Electives	10	These can be chosen by the student to serve the interest-based aspect of the program.

- Engineering Requirements in CHUs

Engineering Compulsory	20	These are fixed, and should be studied by all engineering students.
Engineering Electives	10	These can be chosen by the student to serve the interest-based aspect of the program.

- EE Requirements in CHUs

EE Compulsory	100	These are fixed, and should be studied by all EE students.
EE Electives	40	These can be chosen by the student to serve the interest-based aspect of the program.

- EE Electives

The following are only a few example elective packages that can be offered to students willing to acquire necessary skills that are needed in some professions of interest to them. These packages are assumed to be designed with help and participation from job market experts. Students themselves should also be allowed to take part in refining the details of the elective packages, by asking for the inclusion of new packages and courses, and by requesting modifications to requirements and contents of existing elective courses.

- Example EE Elective Packages

Sales and Marketing	Engineers with sales and marketing knowledge and skills can boost the ability of companies to expand their customer base. Such engineers can also be of great help to customers in deciding which products and/or services to buy.
Statistics and Strategic Planning	This is very important at organization and public service level; where there is big need for experts in the existing and desired popularity of certain technologies.
Law and Legal Matters	Legal departments at organization and companies that are involved in technology-related products and services are often in need of engineers that understand law and legal matters. This is especially important; because on many occasions, organizations and companies get involved in legal disputes with other parties over their products and services.
Support and Customer Services	Support and customer service departments are critically important for the success of most organizations and companies. The quality of support and customer service can be substantially improved when provided by engineers who can efficiently pinpoint the sources of customer needs.

Community Service and Public Awareness	In public organizations, community service and public awareness are usually among their top duties. Clearly enough, this creates need for engineers with good skills in community service and public awareness techniques and procedures.

Many other packages can be added to the list above. Equally important is the need for feedback from the job market and from engineers at work, for the purpose of updating the study plans to accommodate the evolving nature of the technological development and the accompanying societal change.

6. CONCLUSION

We have presented SDIBAL, a self-driven interest-based adaptive learning environment. We have not tried to be comprehensive or exhaustive in going about the topic. We have not claimed that the proposed learning system is an optimum one. However, as a work-in-progress, SDIBAL can be transformed into a very useful educational system by means of further research and fine tuning.

7. FUTURE WORK

Having laid down the concept of interest-based learning in general terms, the next step in this long-term work is to create the computer programming structure of a working SDIBAL prototype system. This includes the specification of many aspects of the development process. Some of these are: programming languages, database systems, internet hosting and web portal, security and privacy measures, availability and reliability, interfacing and access tools, administration and maintenance, and so on. Further in the future, pilot SDIBAL systems will be implemented at sample institutions that show interest in hosting such pilot systems.

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