Web-based Instruction in IT Hardware

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Abstract. *Educational opportunities can be improved by implementing Web-based instruction. A tutorial titled "Methods and Facilities of Information Technology" was conjointly developed as a component of "IT Hardware" undergraduate course and is delivered through the campus networks at three universities in Ukraine and Poland.*

The tutorial content covers the practice of IT in seven modules. Special emphasis is made on the basic concepts implemented in IT hardware. The instructional value of benchmarking and diagnostic/testing tools is also considered, and a practical approach to proper selecting such software is described.

The tutorial was evaluated using data gathered from a post-course survey. A total of 45 questionnaires were returned. Students responded positively to the idea of implementing Web-based instruction and extending it to other courses.

Keywords. Information technology, hardware, Web-based instruction, benchmarks.

1. Introduction

Technology has radically changed the way educational institutions function in an academic environment and the services they provide. However, many universities feel the lack of equipment and limitations of scheduling. Recently Web-based instruction has become a viable alternative to classroom model that may improve educational opportunities and provide great assistance to overcome some of grand challenges to education.

The first challenge is speed. Our universities are simply too slow at what they do. To teach rapidly developing disciplines and IT courses in particular, an educator should, we quote al-Djahiz (an Arabian encyclopedist, the 8th century), "keep pace with time when it flows, and fly with it when it flies". It is obvious that Web-based instruction is a very suitable model to achieve this.

The second problem we face is the commercialization of education. More and more students have to pay for study at universities in our countries. Tuition fee is increasingly growing while universities have no funds to provide financial aid. To respond the needs of busy students working to get money, the instruction should be presented at times and locations convenient to them. Learning needs to be active, self-directed, collaborative, and situated in real-life.

And that is the third grand challenge: how do we deal with students? What is our role and what is our communication style? Most educators were and many of them are rather authoritarians than collaborators to students, their style is more didactic than liberal. Fortunately, introducing new teaching strategies will facilitate liberal changes in an academic environment, because most educational innovations require that students will take a more active role in the learning process. The students taking the Web-based course had to be highly self-motivated and well organized.

Now we come to the final challenge, which is the issue of access. It is very interesting to look back at the recent history of access. Article 19 of the Universal Declaration of Human Rights,

which was adopted in December, 1948, states that, “Everyone has the right to freedom of opinion and expression. This right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media regardless of frontiers.” Many new educational models including Web-based instruction are developed to improve access and make the knowledge, a “global public good”, as widely available as possible.

2. Tutorial outline

The mastering of IT hardware is an important component of the IT literacy curriculum. To address some of the hardware-related skills, a Web-based tutorial, “Methods and Facilities of Information Technology,” was developed as a collaborative project with the faculty of Ternopil State Technical University (TSTU, Ukraine), Lviv Polytechnic National University (LPNU, Ukraine) and Rzeszow University (RU, Poland).

2.1. Access policy

The tutorial was designed as a component of “IT Hardware”, an undergraduate course, and is delivered through the campus networks (Fig. 1).

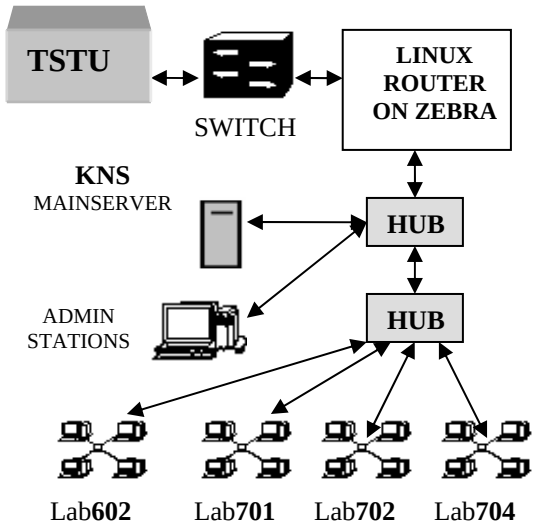

Figure 1. Access to courseware in TSTU network

Users are administered by Microsoft Active Directory and are sorted in three groups: Administrators, Teachers and Students. Courseware is stored on KNS (main server) working under Apache Web Server software. By courseware [1] we mean the collection of coordinated materials and tools specifically produced and used in education as instruments of instruction and delivery of curriculum. Administrators and Teachers can change all educational materials locally or by using hidden SMB shares. Students’ files, such as home-directories, are organized as DFS shares to be accessible from any point of TSTU network. Non-Students’ documents (i.e. educational materials) are available to Students in read-only mode.

The router works under Debian GNU/Linux Woody 3 or 4; rooting software is Zebra, Cisco’s alike system. Two 100 Mbit/s cards are used.

Software installed on the KNS main server includes Windows 2003 Server, Apache Web Server, and FTP-Internet Information Service. One 100 Mbit/s card and two 120 Gb HDD are used.

2.2. Content of the tutorial

The class was presented as a traditional 30-hour classroom course. The content covers the practice of IT in seven modules. Each module includes lecture notes and other information on the topic, recommended reading list, and assignments to reinforce comprehension or to practice skills. This course allowed for gradual but in-depth learning of concepts and principles in information technology. The seven sections of the course are arranged so that students progress from basic subject knowledge to the ability to overcome a particular IT-related challenge through proper selecting, using and adjusting IT hardware.

The first two modules include data compression methods and image formats. Students complete assignments to construct a redundancy-reduction code using the Huffman method and analyze the properties of an information source allowing data compression. They are also offered to draw pictures to understand which one of image formats (.gif or .jpeg) is more effective depending upon picture properties (for example, number of colors). The next three modules include CPU architecture, memory technologies and HDD storage devices. In the last two modules, students summarize their knowledge acquired during the course. They study the motherboard structure to understand the over-all architecture of PC and use monitoring tools to explore PC performance.

3. Introducing the past into the present curriculum

We strongly believe that learning and understanding the processes of IT hardware evolution should occupy an importance place in the process of study IT technologies in order to make the link between the past and the present meaningful for students. When history of one or more hardware components or technology is directly tied to class activity, some positive changes in perception happen. But simply offering the students to go through the chronology of IT hardware (processors, memory, storage devices etc.) would not work, and every educator knows from own practical experience that requests which are not required formally pass unheeded.

Therefore we have made a special effort to indicate the basic concepts implemented in IT hardware (i.e., parallel processing, pipelining or pre-fetch) and show that, in many cases, today's IT solutions are based on the same basic approaches hidden by new names. This will help students to keep pace with IT progress and recognize well known ideas implemented in new-generation hardware that will appear after they complete their formal education.

4. Benchmarking and diagnostic tools

We also consider benchmarking and diagnostic/testing tools to be of great instructional value, especially since necessary software, online help, tips and reference searchable databases are accessible online. However, there is a certain danger, because, as indicated in FOLDOC Free Online Dictionary of Computing [2], "in the computer industry, there are three kinds of lies: lies, damn lies, and benchmarks".

To interpret the relevance of benchmarking and diagnostic/testing tools and then to select proper tools accordingly to the educational needs, a teacher has to check requirements regarding:

- operational system;
- RAM and HDD space sufficient to install and run an application;
- user profile (some test applications can be run only by network administrators);
- availability of special chips providing the information to be analyzed by the application;
- duration of testing (too long tests may be ineffective);
- report modes, both test and graphic options are desirable;
- native language interface if possible.

The reasons to integrate benchmarking and diagnostic/testing tools into the tutorial and other IT-related courses are very pragmatic. Students can see the structure of PC, determine parameters of its components, analyze how well these parameters are coordinated, explore PC performance under different loads, and reveal PC problem areas.

The availability of too many benchmarks may become a problem because they often produce conflicting results when measuring performance characteristics of the same PC components. It is important to realize that this results from software implementation. The simplest solution would be selecting a single application to get comparable results with different hardware. However, the comparison of different benchmarks may allow noticing unusual details provided that specifics of software implementation are taken into account.

Benchmarking and diagnostic/testing tools are available at many Web-sites, but only few of them provide validated and refined information put all in one spot. The role of such resources is that they make possible top-down approach [3] to software selecting. For instance, an extensive archive is supported at **BenchmarkHQ** (*http://www.benchmarkhq.ru/english. html*).

General-purpose toolkits and device-specific applications serve different educational needs complementing each other (e.g. **SiSoft Sandra,** *http://www.sisoftware.co.uk,* and **HD Tach,** *http://www.simplisoftware.com*). The latter ones provide extensive data on individual PC components that makes them effective when students study these same components. In contrast, general-purpose toolkits help to summarize the knowledge of PC at large.

5. Tutorial evaluation

The tutorial was evaluated using data gathered from a post-course survey. Questionnaires were completed by 45 students so that we could learn of beliefs and attitudes towards the Web-based instruction and materials developed during the project. Our analysis of questionnaires shows that overall participant attitude has been positive regarding the Web-

based instruction in IT hardware. Observations made through this project include:

- Most students, 43 (95.6%), prefer Web-based access to assignments, and 2 students (4.4%) indicated that printed materials are more convenient to them;
- 44 (97.8%) students prefer to submit assignment reports in electronic format, and only 1 students (2.2%) printed his reports;
- Most students, 42 (93.3%), have responded positively to the idea of extending Web-based instruction to other courses; 3 students (6.7%) were indifferent.

Table 1 shows the survey results for why students preferred the Web-based instruction

Table 1. Advantages of Web-based instruction

Advantage *	Number and percentage of responses
Allows me to choose when and where to complete assignments	21 (46.7%)
Helps me to meet deadlines	11 (24.4%)
Decreases time to prepare reports	37 (82.2%)
Convenient access to educational materials	22 (48.9%)
Quick feedback to a teacher	25 (55.5%)

* Respondents could check more than one item.

Since any student was allowed to view current results on completing assignments by all students, they were also asked to comment on this "open" reporting. 34 (75.6%) respondents strongly agreed that being informed about all students' accomplishments is very useful, because this makes them to compete. Students answered objective questions but also were given sufficient space to "explain" their responses. These responses have been essential in helping us learn more details. For example, many students indicated that they would like to have an authorized access to Web-based courses via the Internet.

This general course evaluation was considered to be the best way to determine whether this "experimental" project was a good learning experience, what changes to consider, and whether the project should be repeated in subsequent semesters or extended to other courses.

6. Conclusions

The students were very satisfied with the course and with the Web-based instruction and support provided. We believe that this can be credited to three important attributes of Web-based instruction: more time for learning and reflection is available, individual attention stimulates learning, and motivation enhances the learning process.

We debate the quality of new teaching strategies versus existing classical models daily. It is too early to say about possible outcome of those debates. But, when we intervene in the existing system, we need be careful not to damage something that has actually worked rather well. Then the sensible approach, we think, is to experiment, be reasonably skeptical and adapt educational models to the particular field, to the particular discipline. The overemphasis on either classroom or technology-based models seems to be a mistake. It is an issue of choice, the way we teach, the way students study.

7. References

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