HEALTH EDUCATION THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES FOR K-8 STUDENTS: CELL BIOLOGY, MICROBIOLOGY, IMMUNOLOGY AND MICROSCOPY

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ABSTRACT

Within the context of health education through information and communication technologies (ICT), software on different aspects and subspecialties of health has been developed by senior students and lecturers at the Department of Computer Education and Instructional Technologies at Anadolu University. The study briefly abstracts the evolution of health education, articulates its relationship with ICT, provides pedagogical implications, and introduces readers to a computer program, which helps learners develop an understanding of cells, organelles and bacteria along with their structures and functions.

Keywords: Health Education, Cells, Information and communication technologies, K-8 Software

"A healthy mind rests in a healthy body"
M. Kemal ATATÜRK

INTRODUCTION

Conventional perspectives of education involve using diverse educational contents and methods efficiently to accelerate social and economic development. Besides, instructional activities should concentrate on a variety of interrelated notions including effective communication, creative thinking, and productivity. In this respect, educational authorities around the world are obliged to use the new information and communication technologies to teach the skills and knowledge students need in the 21st century (UNESCO, 2002).

ICT is employed in several settings. Health is one of the broadest among those settings for it involves not only hospitals and doctors' offices where the delivery of health services is realized, but also other areas and their subspecialties such as biomedical research, veterinary medicine, dentistry, nursing, allied health, and public health. Moreover, the use of DNA and protein sequences to process biological substances and the application of ICT to support medical research gave rise to the subspecialties of biotechnology and medical informatics (Locatis, 2002). All these subspecialties increase the health's share of the GNP. The public mandate to control cost whilst improving the quality of service probably lead authorities to use information technologies for innovative and efficient solutions (Malato and Kim, 2004).

It can be proposed that ICT had a place in health education from the time of Leonardo da Vinci. Da Vinci's drawings on anatomical structures were the first attempts to illustrate medical knowledge based on observations rather than speculations, superstitions or religious beliefs (Locatis, 2002). In 1910, Abraham Flexner prepared a significant document called the Flexner Report (1910) which served as a great reference for health education professionals since it documented the evolution of health education and called for the introduction of scientific rigor to instructional practices. This report remained unchanged till the advance of problem-based learning (PBL), which encouraged applying attained knowledge to solve problems (Barrows and Tamblyn, 1979). This movement suggested that educational goals could be better attained through exposing students to a rich variety of real and simulated cases. Within the line of PBL, the General Professional Education of The Physician (GPEP) Report issued in 1984 recommended further curricular reforms in health education (AAMC, 1984). More specifically, it called for reduction of lectures, providing more time for independent study, requiring active problem solving and application of information sciences along with computer technology. The next report issued by the Association of American Medical Colleges in 1986 echoed the basic themes of the GPEP Report. Besides, it noted that health professionals should be kept current, and that ICT was an important means to sustain lifelong learning (AAMC, 1986). Benefits of problem-based learning have been cited in further research studies. It has been claimed that students in the PBL programs performed equally well or better than those in traditional programs (Locatis, 2002; Vernon and Blake, 1993). Besides, PBL students had more favorable attitudes about the teaching method in comparison to those in the traditional curricula (Vernon and Blake, 1993). PBL is still very popular today and ICTs are recognized as valuable tools supporting the approach. Thus, it is suggested that anyone interested in instructional design in health settings should be aware of the basics of the PBL (Locatis, 2002).

A large variety of settings for education and training in health could be listed including the schools of pharmacy, health departments, public and private hospitals and clinics, pharmaceutical and biotechnology companies, professional societies, and health associations. Two areas of education and training cut across all above health settings, which are continuing education for health professionals and skills-training for all individuals (Locatis, 2002). Continuing education is required for all health professionals in order to replace the outdated procedures with the current ones via workshops, conferences and other in-service training means. Skills-training addresses all individuals in the society and involves basic skills such as first aid or general health education. In this respect, K-8 institutions host a crucial educational period for they can equip students with basic skills and general health knowledge at an early age. Infants could be considered passive recipients of medical care; however, growing children should be allowed to gradually become the active participant of good health (Nelson, 1979).

Within the framework of health education for elementary school students, Nelson (1979) summarizes the objectives of health education at primary schools. Among those objectives are making sure that students feel good about themselves, providing accurate and concrete information to students about our bodies, thinking of health as an integral part of our lives, viewing children as a vital link and entry to the family, viewing good health as a right, and recognizing the need for changing inappropriate behavioral patterns regarding health. Nelson further suggests that it is important to present information to children at the right time with sufficient exercise. Besides, the information presented must be relevant to the children involved. Finally, measurable goals should be established so that the progress will be observed.

The World Education Forum Report issued in 2000 presents several research highlights from the past decade with a particular emphasis on school health. Among those highlights, the following two cut across all health education settings (Vince-Whitman et al., 2000). First, trained teachers are likely to deliver more fruitful instruction in terms of students' health knowledge than those who are not trained enough. Thus, it is suggested that collaboration between the education and health sectors to nurture lifelong learning should be established. Second, health education is effective when it uses interactive methods in a skills-based approach. More specifically, health learning should emphasize skills-learning over pure health information delivery. ICT facilitates skills-learning and practice on health subjects for it allows the representations and the operations of health processes or systems through the use of real-like and efficient means (e.g., animations, simulations).

Within the framework of health education through ICT, Anadolu University lecturers and senior students created several software environments all of which concentrating on different aspects and subspecialties of health education. The current study is aimed at providing accurate and concrete information to K-8 students on the correct functions of our cellular and viral system. Many attempts have been made to present and simulate molecular processes in both cellular and viral systems (Tomita et al., 1999), some of which presenting the cell division cycle quite efficiently (Novak and Tyson, 1995; Tyson, 1991). These environments involve important details that are quite useful for undergraduate and graduate students majoring in both medicine and biomedical sciences. The present software focuses on teaching the basics of cell structure, functions of organelles and structures of some bacteria on a surface level. The motto will be maintaining the balance between the children involved and the information presented as suggested by previous research (Nelson, 1979), since some details covered in the subject matter can be quite fatiguing for K-8 students.

The cell structure, functions of organelles and bacteria are included in the 6th grade of the curriculum prepared by the Turkish Ministry of National Education (MEB, 2006). Interestingly, students are exposed to chemistry, physics, biology and health subjects simultaneously within the framework of Science and Technology Course. These subjects are not offered as different courses until students enroll in high school. Thus, the software environment presented here is considered a supplementary material equipping students with the basics of cell biology, microbiology, immunology and microscopy within the context of Science and Technology Course.

SOFTWARE

Sample software environments were prepared by senior students at the IDT department within the requirements of the course BTO 402 - Design, Development and Evaluation of Educational Software. The software discussed in this section is adapted from one of those materials. The aim is to equip 6th graders with the basics of cell structure, organelles, and structures and functions of the bacteria covering issues from different aspects of cells including cell biology, microbiology, immunology and microscopy. In terms of cell biology, cell models are provided along with the cell cycle and apoptosis. Viruses and bacteria were covered in terms of microbiology. Anatomy of some malfunctions is provided within the branch of immunology. Finally, the opportunity to enhance several microscope images is provided through a simulation.

Sixth graders are considered at an age where they could be either experiencing the concrete operational stage (7-11 years) or the formal operational stage (11 years and beyond) (Lin, 2002). Thus, it is important to present the abstract subject matter with several concrete elements so that the transmission from the concrete to abstract becomes easier.

The software was developed with Macromedia Flash MX 2004. To generate the annotated illustrations, Photoshop 8.0 was used. Finally, in order to convert SWF files to FLA, Sothink SWF Decompiler was used. System requirements to use the software could be listed as follows: 133 MHz Intel Pentium processor with an operating system of Windows 95, 98, NT 4, 2000 or later; 32 MB RAM; 40 MB of available disk space; 256-color monitor capable of 800 x 600 resolution and CD-ROM drive.

While building the framework of the program, a checklist based on that of Horton was prepared (Horton, 2000). More specifically, the steps to be realized were listed as telling learners about the course, registering them efficiently, running the course smoothly, providing needed resources, acknowledging success, gathering feedback, adding necessary access mechanisms and helping learners over hurdles.

Learners are told about the content of the course both on the title page and the objectives page. Besides, the designer of the software is also introduced as suggested by Horton (2000). Students are free to skip the introduction, which is supported with audio-visual materials. After the introduction, they are registered in the login page where they are expected to sign in through their user names and passwords or sign up as a new user by providing their names, user names, passwords, e-mail addresses and a security question in case they forget their passwords. The login page is followed by the welcome page which constitutes the central of the course to run the material smoothly. Links to topics to be covered, objectives page, evaluation page, dictionary to provide students with needed resources, help page to assist learners over hurdles, and copyright page are provided on the welcome screen.

Figure 1. Links to most submenus are presented in the welcome page of the program

Students are expected to click one of the links provided on the welcome page. The start button is located in the middle of the page. When students click the start button, they are transferred to the pre-test page where their prior knowledge on the subject-matter is evaluated through 5 multiple-choice questions (Figure 2).

Students are informed about the number of correct answers they get on the pre-test along with relevant feedback. They are free to go on studying even if they get all of the questions right. On every single page including the pre-test, students have access to the main page, objectives page, topic list, dictionary and help menu.

Figure 2. Pre-test screen appears as soon as students start the course

As students pass through the pre-test, they see the list of subject matters they need to cover to finish the course. They are free to follow either a linear or non-linear order according to their interests. Each topic is supported with annotated illustrations (Figure 3).

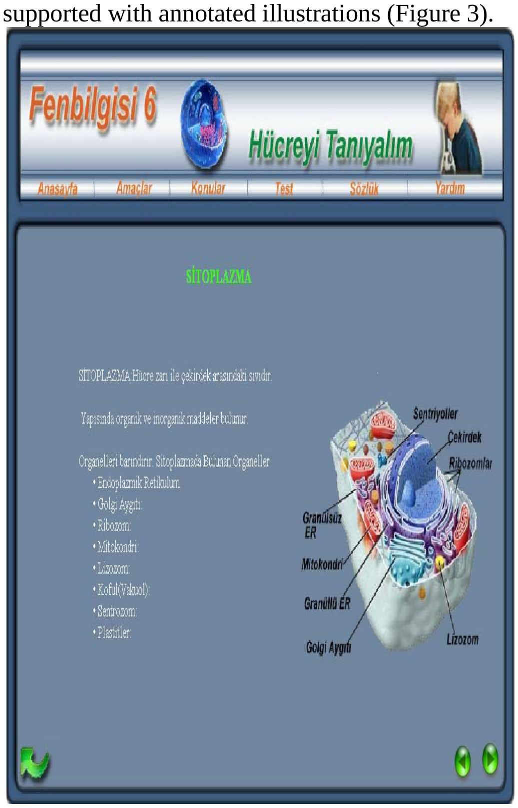

Figure 3. Each topic is supported with annotated illustrations

All of the annotated illustrations presented to the students are based on general design principles based on research (Levin and Mayer, 1993; Mayer, 2001). More specifically, the pictures are concentrated where the key ideas are highlighted. Extraneous descriptions are minimized both in the text and in the pictures. Finally, corresponding pictures and text segments are presented near each other on the page. On each page, students have an option named "watch animation" where they are exposed to short video clips in order for them to get the gist of the subject-matter with audio-visual materials.

Students have the links to the evaluation section on each page. Besides, they have access to the dictionary where they can find the definitions of 15 terms covered within the unit. At the end of the unit, there is also a game section where students can magnify some of the bacteria and organelles with a simple electron microscope simulation.

Figure 4. Students can magnify some bacteria samples through the electron microscope

CONCLUSION

It is claimed that previous studies in biochemical software environments limited their models to focus on only one or a few of the several levels of the hierarchy in cellular processes (Tomita et al., 1999). Reducing the gaps among various levels of cell structure is a challenging task particularly when the addressees of the software environment are at an early age for they can have problems in understanding such complex and sometimes abstract notions. In this respect, the topic concreteness was realized to some extent through animations, videos, annotated illustrations and simple simulations.

The current software focused on several aspects of cells including cell biology, microbiology, immunology and microscopy. Such a procedure was followed so that the material would be useful for the curriculum followed by the Turkish Ministry of National Education. As mentioned above, the curriculum covers chemistry, physics, biology and health within the framework of Science and Technology course.

The software environment presented here probably poses several limitations for it was developed within a short span of time by a small and novice design team. Thus, it could be considered a demo for evaluative purposes. Formative evaluation of the software by students, teachers and instructional designers is necessary, so that, the instrument can serve better each time it is used.

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