

Computer Science Education: Differences Between E-learning and Classical Approach

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Abstract: Computer Science Education is a course held at the Faculty of Science, Department of Physics. By means of the Bologna Declaration, we are trying to tune with academic tendencies in the rest of the Europe, hence, the rest of the world. In this article we are discussing differences between e-learning and classical approach in Computer Science Education. Under “classical approach” we connote approach in which we have four basic elements – chalk, blackboard, lecturer and students. The goal is to improve the quality of knowledge students get while attending courses at the Faculty, thus making future physics and computer science teachers being able to follow tendencies in the world of computer science and physics.

Computer Science Education in General

Computer Science Education, as stated in the abstract, is a course held at the Faculty of Science, Department of Physics (DoP in the following text). At the DoP students are given a choice of six orientations: they can study to become engineers of physics (equivalent to B.Sc. in physics, level of qualification is *University graduate program leading to a Diploma on successful completion of a study program of 240 ECTS credits*), physics teachers, and, in the end, physics and [mathematics, chemistry, technical culture, computer science] teachers (equivalent to B.A. / B.Sc. in education of physics and [mathematics, chemistry, technical culture, computer science], while actually it is *University study of educational physics*). In this article we will concentrate on students of the orientation physics and computer science.

As stated before, till now, Croatian higher education system was incoherent with the rest of the world. At the DoP undergraduate study program was consisted of eight semesters, after which student could get a degree in equivalent of B.Sc. Bologna Declaration will implement another kind of study, popular called "3+2 system". This means that three years are required for an undergraduate study program, and another two years for a graduate study program.

Computer Science Education (CSE in following text) is held as a course in the fourth year (7th and 8th semester) of the orientation physics and computer science (PCS in the following text). CSE requires for students to adapt methods and technologies that are required for future teachers and to implement them. CSE also consists of

praxis, which is implemented in primary and high schools in Zagreb. After completion of the course, student is able to hold courses in the domain of computer science.

In the following text, we will try to compare two approaches, thus giving the base for future discussions on the issue of Computer Science Education and educational system all together.

E-learning Methods and Concepts

What is e-learning, actually? Probably the best explanation would be that e-learning is a method of using the multimedia and Internet in function to improve the quality of learning by enabling the access to distance sources & services and distance collaboration and communication.

E-learning is also characterized by following terms (which give the “e” in e-learning):

- Electronic learning – the main medium of the learning is a computer, with all the advantages of the Internet, intranet, database systems and applications that make the system easy-to-use and easy-to-manage,
- Everywhere learning – the student is not bound to one place – the computer can be used wherever there is a computer and Internet access,
- Enterprise learning – education is of the utmost importance for the academic community, this way we can offer the materials even to the graduated students to help them improve their knowledge even after the graduation,
- Experience learning – the system treats the student as a solver of the problem, it simulates real-life situations, thus making the education interactive and exciting, it enables to student to test the knowledge and, if needed, to get help from the mentor.

Some of the key components needed for successful implementation of e-learning are:

- Content Design
- Learning Management System (LMS)
- Collaboration

Content Design

Content is the key part of the learning process. E-learning offers multimedia experience by using images, sounds (voice), animations and videos. Content design is focused on the need of a student to apply his/her skills to solve a real-life problem. Educational goal of e-learning should be to maintain a healthy balance between classical student-oriented and mentor-oriented centered types of learning. Learning modules are not static, in most cases they simulate a real-life situation, but, in contrast to classical approach, mistakes are signalized momentarily and are also used as a part of the learning process. Also, there is a possibility to coerce a student to repeat a step in learning process for as many times it is necessary, until the goal of the module is accomplished.

Learning Management System (LMS)

As a part of the decision to use e-learning in a course, the lecturer has to decide which LMS to use. What is LMS, actually? LMS is a set of standardized components based on standards AICC, IMS, IEEE/LTSC, and ADL/SCORM. They are designed in that order to bind together learning with already existing information system or by means of a web portal. Unfortunately there are four standards, but organizations behind them are not unified, so the creation of the unified standard is very questionable (at least in the near future).

One of the most popular LMS's in our community is WebCT. But, since it is a commercial product, that needs to have valid licenses to work, we are considering switching to open-source alternatives. At the moment, for one of the courses at the DoP, we are designing materials that are based on Claroline LMS. Claroline is an open-source LMS, which complies with almost all of our demands. Also, we are working with the development team in Belgium on a localization of the LMS so that our students without the intermediate knowledge of the English language can work/study on LMS web portal.

Collaboration

Communication in the system of e-learning is multidimensional. Primary goal of the communication is the collaboration between the students (collaborators) and the mentor, but also the communication between students themselves. By using e-learning methods and technologies, collaboration is brought to the highest level. Students, as stated before, have no need for a physical presence in the classroom, but the collaboration is achieved (by the means of LMS – e-mail, forum, chat, whiteboard, etc.). The most important part of the collaboration is the exchange of experiences and advices.

Advantages of E-learning

Expenses

Considering expenses that students and lecturers have when they have to buy the books, notepads, pens/pencils and other materials for courses, with e-learning approach we can reduce these expenses. One of the crucial requirement is of course possession of a computer. If this requirement is not met, students are always able to follow the course in the computer lab at the DoP (at the spare time). Following table shows the calculation of expenses for a student and a lecturer (based on one academic year and ten different courses).

	Student	Lecturer/DoP
Books	300 – 500 \$	500 – 5000 \$
Notepads	0 – 50 \$	50 – 100 \$
Pens/Pencils	0 – 30 \$	50 – 100 \$
Personal computer	500 – 1000 \$	5000 – 6000 \$
Transportation & Food	100 – 200 \$	3000 – 5000 \$
Exams	0 – 20 \$	0 – 2000 \$
Other	0 – 100 \$	500 \$
Total	900 – 1880 \$	10100 – 18700 \$

Table 1: Calculation of expenses – classical approach

Of course, this is a rough approximation, but it is a very close one. Lecturer gets covered for his expenses by the DoP, so there are no real expenses. Following table shows the calculation of expenses for a student and a lecturer if e-learning is used.

	Student	Lecturer/DoP
Books	300 – 500 \$	500 – 5000 \$
Notepads	0 – 20 \$	0 – 50 \$
Pens/Pencils	0 – 10 \$	0 – 50 \$
Personal computer	500 – 1000 \$	5000 – 6000 \$
Transportation & Food	50 – 100 \$	2000 – 3000 \$
Exams	0 \$	0 \$
Other	0 – 50 \$	100 \$
Total	850 – 1680 \$	7600 – 14200 \$

Table 2: Calculation of expenses – e-learning

As stated before, these calculations are a very rough approximation, because, in real-life situations, students don't buy a personal computer every academic year, it is often used for at least 2-3 years. But, if we analyze the data, we can see that the difference is not that big – about 200 \$, maximum (for a student). We even don't have to analyze the data for the lecturer, because the expenses are covered from the DoP funding. But we have to consider the financial state of the DoP – by using the e-learning methods, we can minimize the expenses for the DoP to an

eligible level – for example, the price of exams falls from 2000 \$ to 0 \$. Perhaps this is the most important part of the calculation, because, it is a very-well known fact that if something is free, or even minimizes the current expenses, it will be accepted *a priori*.

Accessibility

Perhaps one of the most important advantages is definitely the accessibility of the study materials. If a student is unable to participate in the course (illness, for example), he/she doesn't get the necessary materials for study. If it is a longer absence, it automatically means that the student is unable to pass the course, thus losing a year of study. By means of e-learning, student is able to study by the materials and take the necessary exams to successfully complete the course. Of course, praxis part of the course is something that is impossible to implement by the means of e-learning.

Comparison of E-learning and Classical Approach to Education

If a lecturer chooses to use e-learning in a course, he/she should be aware of the following:

e-learning is	Classical Approach is
Non Linear	Linear
Dynamic Process	Static Event
Learner Controlled	Instructor Controlled
Platform Independent	Platform Independent
Knowledge Management	No Knowledge Management
Multi Channel Communication	Dual Channel communication

Table 3: Comparison of e-learning and classical approach

As stated in the table above, terms which describe e-learning, as a concept opposed to classical approach, are almost completely opposite. The only thing connecting them is “platform independent”.

Non Linear vs. Linear

In non linear way of learning, students determine how, what and when they access the information. Also, as stated before, students decide where to access the information. On the other hand, linear approach gives students the possibility to learn by a predefined order, which can be good or bad – students are not obligated to arrange the information in proper order – as opposed to e-learning, where students might have to learn completely by themselves, sorting the information as they find fit.

Dynamic Process vs. Static Event

Dynamic process – student is allowed to transform, personalize and customize learning materials. Also, all the materials are at disposal just-in-time – there is no need to wait for the lecturer to copy materials for all students or to prescribe the materials from another student. If we approach learning as a static event, we can always arrange our free time, considering the fact that lectures are always held at the same time. Students have no need to extra arrange their time thus making it easier to concentrate on the learning itself.

Learner Controlled vs. Instructor Controlled

If a student is allowed to control the interaction with the content and presentation, he/she is under a pressure to fulfill the responsibilities given to him/her by a lecturer. On the other hand, if a student is not allowed to control the interaction, when this is the job of a lecturer, who determines sequence, content, media and timing, the student is also under a pressure to fulfill the responsibilities. This means that students should be allowed to choose the time, sequence and content that will be learned, thus making it self-paced. This is directly correlated with Dynamic Process paragraph above.

Platform Independent

This is the only part that is common to both approaches. In e-learning it connotes that it is not obligatory to have specific software to smallest detail to access the information, and in classical approach it connotes that, e.g., it is not required to sit in predetermined classroom or laboratory to get the information – it can be done in every classroom or laboratory.

Knowledge Management vs. No Knowledge Management

Students can access study materials from wherever they choose – after that, when they acquire the information, it is up to them to organize them in a way they find easiest to learn. No Knowledge Management is a very big problem in classical approach. Since students have to organize the information on-the-fly, they are unable to organize it properly in a way that will make them easier to learn. They can do this process afterwards, but this means they will have to lose more time than planned. With Knowledge Management students organize materials as they find fit, which is directly correlated with above mentioned Learner Controlled and Non Linear paragraphs.

Multi Channel Communication vs. Dual Channel Communication

If we use e-learning, students are allowed to communicate with each other, but they don't interfere with other students that have other obligations at the moment. For all time of the learning process, students are encouraged to communicate and above all, collaborate on solving the problems. Having only dual channel communication, we strip students of the possibility to “brainstorm”, thus making the learning process incomplete. Learning process should definitely allow students to “brainstorm” because in this way we allow new ideas to become a part of the learning process, and even subsequently integrate them in to the learning process itself.

Examples of Current E-learning Courses at the Faculty of Science

Currently, two courses are held by methods of e-learning at the whole Faculty of Science, both of them at DoP: “Usage of Computers in Education” (PCS orientation only) and “Computer Networks” (physics and technical culture and PCS orientations). Usage of Computers in Education partially implements e-learning methods, while the Computer Networks course almost completely follows the postulates of e-learning. Currently, materials for the latter course are being designed with the association of Computer Networks course chair, assistant professor at the DoP, Darko Androic, PhD.

Usage of Computers in Education

Goal of this course is to educate future teachers on technologies surrounding them and implement them in physics and computer science courses at high schools. It is held in the third year of the PCS orientation (6th semester).

WebCT is used as a form of front-end, but students are still obligatory to attend the lectures at the laboratory (however, per-student basis, at their free time). All the materials and information student get via the

WebCT portal, including e-mail notifications (since the WebCT team has implemented an e-mail service in the application). The most important part of the course is a production of web sites with correctly implemented tasks given in laboratories, using technologies like HTML, PHP, ASP & databases, and applications like Macromedia Dreamweaver, Macromedia Flash, Microsoft FrontPage, etc.

Computer Networks

This course is held at the same time for students of two orientations (physics and technical culture – 5th semester and PCS orientation – 7th semester), considering the fact that students of physics and technical culture orientation often lack in knowledge of computer science in generally (in comparison to PCS orientation), and in some parts it is customized to fit their needs.

Students in this course learn about computer networks in general (OSI and TCP/IP model, TCP/UDP group of protocols, IP based services, wireless and mobile technologies, security of computer networks, etc.).

Lectures are held exclusively via the LMS (Claroline), giving students opportunity to learn as they find fit. For security reasons (cheating especially), mid-term exams (three of them) are held at the computer lab under supervision. Mid-term exams are not obligatory for the students – if they believe they will gather enough points via the seminar and short exams, they do not have to attend mid-term exams. Public seminar at the end of a semester, on the other hand, is obligatory.

Work to be Done

Following the example of DoP, other Departments (Chemistry, Geology, Mathematics, Geophysics, Geography and Biology) should devise plans on e-learning implementation in courses that are adaptable to this method of learning.

Future plans are not only to improve the quality of currently held courses, but also to implement e-learning methods in courses such as Computer Science Education.

Conclusion

Computer Science Education is a very heterogeneous course since it implements a few of classical learning methods – lectures, praxis, discussion, seminars, lab work and exams. Some of these parts must maintain in the area of classical learning methods (classical approach), because they require face-to-face approach (praxis and discussion), but others can easily be transformed to materials that fit requirements that e-learning places.

Working also on the project of designing the materials for Computer Networks course, we were able to conclude that some parts of the course-matter demand face-to-face approach, where students are allowed to make observations on-the-spot (e.g., installing and configuring an operating system). The expenses should also be considered, not from a student point of view, but from the view of the lecturer, hence, the organization providing the higher education. Accessibility should be one of the key parts in making the decision to switch to e-learning (at least partially), because the main argument should be the satisfaction of the student with the course.

In conclusion, we would like to state that e-learning is the perfect method of learning only if it is combined with classical approach. The lecturer (in most cases also the Course Designer) should decide in which extent to use e-learning in contrast to classical approach.

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