THE BENEFITS FROM HUMAN-COMPUTER INTERFACE EDUCATION FOR THE FUTURE SPECIALISTS IN COMPUTER SCIENCE

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Abstract. University education aims to ensure students that they will gain a high level of professional income after graduating. Human-computer interaction envelops an essential part of the competences in the Computer Science area. This study argues the importance of including Human-computer interaction and its applicability in Computer Science curricula. The authors conduct a review of the Computer-Human Interaction recommendation and research presented by the Association for Computing Machinery Special Interest Group. We investigated the Human-computer interaction curricula in some world-famous and Bulgarian universities. The authors shared their experience in developing Human-computer interaction curricula through the usage of didactic principles in the e-Learning course. We summarised students' achievements by years.

Keywords: Human-Computer Interaction, Human-Computer Interface, Higher Education, Computer Science

1 Introduction

The global digital economy is developing dynamically and is an important driver of innovation, competitiveness, and growth, with great potential for entrepreneurship and small and medium-sized enterprises. Currently, according to data from European commission [17], only two percent of European businesses take full advantage of new digital technologies. The positioning of European businesses, Bulgarian companies in particular, will be concerned with the acceptance and adoption of digital technologies, and will become a key factor for their progress and survival over the next decade. The digital economy covers diverse activities, business models and technological solutions. On the one hand, the development of e-business and e-commerce, automated industrial production and intelligent manufacturing enterprises, intelligent transport systems, and vehicles, intelligent energy systems, Cloud and Internet technologies, including the IoT, Big Data, robotics, artificial intelligence are the main technological prerequisites for the development of the digital economy. On the other hand, public sectors such as e-government, e-health, e-education, and the development of smart and connected cities

are a natural field of application for products and services created by the digital economy. Linking technological development with active action to develop policies and models to support the digital economy is crucial because they affect all areas of the economy and public life. The adoption of common technology standards is one measure to ensure that European industries are at the forefront of the development and use of new technologies. They pledge the interoperability of the systems and guarantee their reliable operation, as well as compliance with the requirements of confidentiality, security, and accessibility. Advances in digital technology, in combination with other core technologies, are changing the way we research, develop, produce, market, and generate value from products and related services. Digital goods can reach 3.2 trillion euros in the G20 countries and are already contributing to 2.8% of GDP, leading to growth and job creation. It is important to note that over 75% of the value added generated by Internet technologies is in traditional industries and is due to increased productivity [17].

Industry 4.0 lets you meet the individual and customer-specific criteria for design, configuration, ordering, planning, production, and operation, including the desire option to make changes in a short time. With Industry 4.0, even the production of single items (batch of one product) can be cost-effective [8].

The above-described features of our modern reality lead to a needed change in the software industry in all its aspects. Computers, related devices and software systems demand establishment with the understanding that people have specific tasks to solve and want to use them in a way that is seamless in their day-to-day work. For this purpose, those who design these systems should know how to think about the possible tasks of users and how to translate that knowledge into a workable system. Currently, there is a problem in trying to teach people to design software systems for use by diverse user groups. Software developers are human and most likely users; therefore, the following questions are reasonable: Is it not intuitive to design software systems? Why is there the need of being taught when we all know how a good interface looks?

As a result, the knowledge in the human-computer interface (HCInterface) tends to come along late in software specialists' education, if it exists at all. The scenario with which we started shows that this is a mistaken point of view; it is not at all intuitive or easy to design consistent, robust systems that will cope with all manners of user carelessness. The interface is not something that can be pluged in at the last minute; its design should be integral with the rest of the system. It should not just present a ‘pretty face’. In stead, it should support the tasks that people actually want to do and forgive the careless mistakes. We, therefore, need to consider how HCInterface fits into the design process.

As Dix points out „Designing usable systems is not just a matter of altruism towards the eventual user or even marketing; it is increasingly a matter of law. Governmental health and safety standards constrain employers to provide their workforce with suitable computer systems: not just safe, but usable. For example, EC Directive 90/270/EEC, incorporated into member countries’ legislation, requires employers to ensure the audience or public when designing, selecting, commissioning or modifying software: that it is suitable for the task; that it is easy to use and, where appropriate, adaptable to the

user's knowledge and experience; that it provides feedback on performance; that it displays information in a format and at a pace that adjusts the user; that it conforms to the "principles of software ergonomics"[15].

This requests for more time to be allowed for the study of HCInterface in the education of future specialists in the computer science area. Immediately the question arises: 'What knowledge and skills should software technology professionals have?'. We could summarize that computer science area professionals should have basic methods in analyzing, specifying, developing, testing, validating, documenting, and maintaining software systems. They should be able to use and create software in various fields of human activity, applying modern approaches, models and techniques to build appropriate solutions, demonstrate the ability to communicate well and to resolve conflicts. IT professionals should have the skills to manage software projects and teamwork. From all of the above, the knowledge and skills required of a quality software specialist are very diverse and arise from different scientific fields.

2 Nature of the discipline Human-Computer Interaction

How to make the interfaces between individuals and machine-usable effective, and efficient? The answer to this and many other similar questions is what the multidisciplinary subject Human-computer interaction (HCInteraction) tries to discover. It brings together expertise from computer science, cognitive psychology, behavioural science, and design to help understand and facilitate better cooperations between users and machines.

Due to its multidisciplinary nature, many different definitions characterize the discipline in some of the many aspects it covers. In 1996, Association for Computing Machinery (ACM) Special Interest Group on Computer-Human Interaction (SIGCHI) defined HCInteraction as "a discipline concerned with the design, evaluation, and implementation of computing systems for human use and with the study of major phenomena surrounding them" [15]. The authors provide an overview of the subject of HCInteraction as "… a design that should produce a fit between the user, the machine and the required services to achieve a certain performance both in quality and optimality".

Discussions related to HCInteraction education began a few years after the creation of the ACM SIGCHI. In a 1989 ACM SIGCHI Bulletin article titled 'A vision of education in the user-centred system and interface design', Ronald Baecker outlined "a proposal for a new curriculum in human-computer interaction and user-centred system and interface design" [5]. At the time, Dr Baecker already alluded to the "incredible breadth of focus" of our discipline. A few years later, in 1992, his vision, and the ones of his HCInteraction colleagues, materialized in the form of the first version of the ACM SIGCHI Curricula for HCInteraction [18]. For many years, this document, known as 'the green book', served to inform the design of many HCInteraction programmes.

By the mid-2000s, the discipline of HCInteraction experienced numerous changes with the proliferation of mobile phones and social media, and the development of ubiquitous computing devices. Many educators recognized the need for updated HCInteraction curricula. As a result, the ACM SIGCHI Executive Committee sponsored a project to investigate the present and future of HCInteraction education from 2011 to 2014

[11]. A recurring theme that emerged in the findings from the project was the desire for a collection of online resources shared among HCInteraction scholars and educators, sharing and collaborating to develop course outlines, curricula, and teaching materials, known as the HCInteraction living curriculum [12]. Undoubtedly, HCInteraction pervades every aspect of life in the 21st century. From augmented reality to social media to autonomous vehicles to crowdsourcing, the study of HCInteraction impacts all of us [9].

Human-Computer Interaction knowledge helps computer science specialists to make information technology interesting, useful, and enjoyable. Today, when information technology is an essential part of almost every single product and service, designing it properly is more important than ever. Whether you want to reinvent mobile phones, construct advanced tools for professionals, invent the next social media or empower people with disabilities, additional expertise in HCInteraction is crucial. Due to the fact that HCInteraction is a multidisciplinary subject which focuses on computer design and user experience, it equips computer science specialists with both the theory and practice required to design well-functioning and innovative information technology interfaces, artefacts and services.

HCInteraction is the study, planning and design of the interaction between users and computers. It regards the intersection of computer science, behavioural sciences, design and several other fields of study. There is currently no agreed-upon definition of the range of topics which form the area of HCInteraction, but some working definitions allow for the practical work of deciding what is to be taught. One of them notes:

"HCInteraction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [18].

Research in HCInteraction has been spectacularly successful and has fundamentally changed computing [24]. In the past four decades, HCInteraction has progressively integrated its scientific concerns with the engineering goal of improving the usability of computer systems and applications, thus establishing a body of technical knowledge and methodology. One of the most important fields of HCInteraction for us is the Human-Computer Interface (HCInterface) and its design.

The objectives pursued by HCInterface training are to teach principles and techniques for design and development, both usable and secure systems, but also functional. Of particular importance are the project construction and test methods for the prototypes' development and evaluation, and the psychological aspects of HCInterface.

The long-term goal of HCInterface is to develop systems which minimize the barrier between the human model understanding of what is required from the computer and the actual computer "perception" of the user task. This objective is the basis for building the subject's training. People dealing with HCInterface are interested in developing new design methodologies, experimenting with new hardware devices, prototyping new software systems, explaining new paradigms of interaction and development of new models, and theories of interaction.

In order to produce easy-to-use computer systems HCInterface professionals should:

- Understand the factors (physiological, ergonomic, organizational and social), which determine how people handle and make efficient use of computer technology;
- Apply this understanding to tools and technique development, that help the designer provide a computer system, suitable for users;
- Achieve efficient, effective and safe interaction with individual and group HCInterfaces [2].

The term HCInteraction has only been in widespread use since the early 1980s but its roots can be traced back to more established disciplines. The systematic study of human performance began in earnest at the beginning of the last century in factories, with an emphasis on manual tasks. The Second World War provided the impetus for studying the interaction between humans and machines, as each side strove to produce more effective weapon systems. This led to a big concern among researchers, and the formation of the Ergonomics Research Society in 1949. Traditionally, ergonomists have been disquieted primarily with the physical characteristics of machines and systems, and how this affects user performance. Human Factors incorporates these issues and more cognitive points as well. The terms are often used interchangeably, with Ergonomics being the preferred term in the UK and Human Factors in the English-speaking parts of North America. Both of these disciplines are affected by user performance in the context of any system, whether computer, mechanical or manual. As computer use became more widespread, an increasing number of researchers specialized in studying the interaction between people and computers, concerning themselves with the physical, psychological and theoretical aspects of this process. This research independently went under the name 'man-machine interaction', but became HCInteraction in recognition of the particular interest in computers and the composition of the user population.

HCInterface draws on many disciplines, as we shall see, but it is in computer science and systems design that it must be accepted as a central concern. For all the other disciplines it can be a specialism, albeit one that provides crucial input; for systems design, it is an essential part of the design process. From this perspective, HCInterface involves the design, implementation and evaluation of interactive systems in the context of the user's task and work.

However, when we talk about HCnteraction, we do not necessarily envisage a single user with a desktop computer. By user, we may mean an individual user, a group of users working together, or a sequence of users in an organization, each dealing with some part of the task or process. The user is whoever is trying to get the job done using the technology. By computer, we mean any technology ranging from the general desktop computer to a large-scale computer system, a process control system or an embedded system. The system may include non-computerized parts, including other people. By interaction we mean any communication between a user and computer, be it direct or indirect. Direct interaction involves a dialogue with feedback and control throughout the performance of the task. Indirect interaction might involve batch processing or intelligent sensors controlling the environment. The important thing is that the user is interacting with the computer to accomplish something [15].

3 The HCInteraction attitude to ensure high quality computer science professionals

Higher education aims to equip students with skills and knowledge adequate to the business requirements. For this reason, future specialists in the field of computer science should be familiar with the various influences of the human factor in the development and usage of software systems.

HCInteraction has long been a focal area for innovative, multidisciplinary computing research and development. Twenty years after a new millennium began, it is time to ask where this increasingly important field is going. Are the new forthcoming specialists in computer science ready to develop the HCInteraction? Could they improve and appreciate the new exciting and stimulating ideas for the future of our interactions with computers [4]?

Increasingly, therefore, computer science educators cannot afford to ignore HCInterface. We would go as far as to claim that HCInterface should be integrated into every computer science or software engineering course, either as a recurring feature of other modules or, preferably, as a module itself. It should not be viewed as an 'optional extra' (although, of course, more advanced HCInterface options can complement a basic core course). This view is shared by the ACM SIGCHI curriculum development group, who propose a curriculum for such a core course [2].

Because HCInterface's primary goal is to enable users to complete their tasks safely, effectively, efficiently, and pleasantly, HCInterface is essential for any computer science curriculum [6, 15, 19, 26, 29].

3.1 Current state

First of all, we are going to discuss the HCInteraction learning process worldwide. In 1985, the ACM SIGCHI workshop on curricula in HCInteraction [23] proposed the development of courses in HCI [18]. Since then, numerous individual courses have been developed and instituted in many parts of the world [28]. The main courses proposed for the curricula can be seen in Table 1.

Table 1 relates the content of HCInteraction and the emphases of each topic for each of the four advanced courses. All courses proposed in the curricula could be broadly characterized as either technology-oriented (CS1: UI Design and Development and CS2: Phenomena and Theories of HCInteraction) or human-oriented (PSY1: Psychology of HCInteraction and MIS1: Human Aspects of Information Systems). Also, they are moving from a general professional/practical orientation (CS1 and MIS1) to one that is more specialized and research-oriented (CS2 and PSY1). Furthermore, the courses should be specified, depending on the type of students – hardware or software oriented; bachelor, master or PhD etc.

Table 1. Course Emphases on the Content of HCInteraction [18]

CONTENT AREAS (course length assumed to be 14 weeks with 42 contact hours total)		CS1: UI Design & Devel.	CS2: Phen& Thy of HCI	PSY1: Psych of HCI	MIS1: Human Aspects of IS
N	**The Nature of HCI**				
N1	(Meta-)Models of HCI	2	2	2	1

U	**Use and Context of Computers**				
U1	Human Social Organization and Work	2	4	4	4
U2	Application Areas	1	1	1	4
U3	Human-Machine Fit and Adaptation	2	2	4	3
H	**Human Characteristics**				
H1	Human Information Processing	1	9	4	1
H2	Language, Communication and Interaction	1	5	2	2
H3	Ergonomics	1	2	1	1
C	**Computer System and Interface Architecture**				
C1	Input and Output Devices	2	0	3	2
C2	Dialogue Techniques	3	0	4	3
C3	Dialogue Genre	1	0	1	1
C4	Computer Graphics	1	0	1	1
C5	Dialogue Architecture	1	0	1	0
D	**Development Process**				
D1	Design Approaches	4	2	4	4
D2	Implementation Techniques	5	2	2	4
D3	Evaluation Techniques	5	6	4	3
D4	Example Systems and Case Studies	3	2	2	4
P	**Project Presentations and Examinations**	7	5	2	4

There are many existing HCInteraction courses in colleges and universities around the world. Although the scopes of these courses are broad, more or less, they are related to specific industrial requirements, such as web chat interfaces or 3D interfaces design [29].

A large number of HCI courses have been taught in North America, Europe and Asia over twenty years [3, 7, 12, 22, 27]. Here are a few sample courses offered, such as: CS376: Research Topics in Human-Computer Interaction [14]; CS260: Human-Computer Interaction Research. [13]; CSEl70: Human-Computer Interaction Design [21]; MSC/LEVELll: Human-Computer Interaction [20]. These courses usually require students to complete one or more projects.

Now, we'll focus on how students in Bulgaria learn HCInteraction. In our country, the education in Computer science is already well developed. But it is not the same for including HCInterface in the computer science curricula in different universities. As could be seen from Table 2, only a few universities have courses, which are oriented only to HCInterface.

Table 2. HCInterface courses in some Bulgarian Universities

University	Course Name	Students degree
Sofia University	Human Computer Interface Design	Bachelor Master specific course
Rousse University	Human Computer Interface	Bachelor (compulsory)
Technical University – Varna	Human Computer Interface	Master

University of Library Studies and IT	Human Computer Interface Design	Bachelor (eligible)

There are lots of courses, which include parts of technical oriented aspects in HCInteraction. But the time and themes provided are too short and not enough for such an enormous subject. Commonly, there are almost no courses, which deal with human aspects of HCInteraction.

3.2 Our work

University is the place where teaching and interpretation of objective knowledge are carried out. Some of the lecturers are scientists and researchers with contributions to the disciplines they teach. The other part is only moderators who transform the knowledge and make them known of students at various levels of accessibility and with different success. Depending on the teacher's skills to attract students to science with an attractive presentation of lectures, their behaviours are mostly determined - whether they will be passive listeners or active participants in the learning process. The leading factor remains the personality of the lecturer - to determine the activity of the students during the lectures and to form a positive attitude towards training. By his/her behaviour, with his/her erudition, the academic lecturer puts the first challenge to the activity of the students, thus enhancing the personal positive attitude towards learning in somebodies and helping to form a positive attitude towards learning in others.

Hundreds of world-class seminars are dedicated to improving the learning process. In the field of HCInterface we stated the following problems: There is a lack of training systems, which are suitable and ready for education purposes usage. There is a lack of experience in building training, in which the student must be the active side. The available literature is available in English. Some Bulgarian students have problems with this. There is a large variety of developed software systems and they have various types of interfaces. Future computer science specialists should be familiar with them in ordet to be able to use them sufficiently.

3.3 The Global Trends for Acquiring Knowledge and Characteristics of e-Learning.

The development of information and communication technologies brings changes in all spheres of our life. Education is a relatively conservative area where it is difficult to change established methods. However, electronic learning has been practised for more than 10 years now. This led to the realization of different variants of training in which the teacher and students are physically separated and use technology for communication and interactive learning tools. Advantages and disadvantages of electronic and distance schooling have widely been discussed. However, these types of education are being approved and forcefully imposed due to the following traits: Independence from the place of convenience; time efficiency; accessibility; collaboration in work; flexibility.

The above described positive characteristics of e-learning show that HCInterface discipline is very appropriate, and it meets the purpose for which it was developed. E-course on HCInterface provides students with the following opportunities: personal

choice of time, place and speed to gain knowledge for different interface models; personal choice of learning units; opportunity to discuss problems and uncertainties about studied material, with fellow students and with faculty. The presence of this course on the Internet allows students at a later stage of their training to recall forgotten basic concepts of HCInterface and to restore their knowledge.

3.4 Didactic principles we apply in the HCInterface course

Based on an analysis of the general didactic principles for the construction of a training process, their applicability was sought to train future computer science specialists in the field of the human-machine interface. Learning process researchers define the principles of learning as a system of fundamentals, guiding ideas or standard requirements that determine the overall activity of trainers and trainees in the learning process [16, 25]. They are the theoretical basis for determining the content of the curriculum, so they have a fundamental place in pedagogical science, which determines the proper planning and implementation of the learning process. P. Petrov proposes that the following principles are laid down in the subsequent order:

Principle of Science. It relies on the natural link between science and the subject. Requires the content of the course to be based on objective scientific facts, concepts, laws, theories of the relevant field, and to reveal contemporary scientific achievements. Targeted at the components of the learning process in the human-computer interface, this principle predetermines: socially determined learning goals and scientifically precise practical tasks, addressing contemporary scientific and applied problems, use of proven methods, approaches and good design practices, understanding and validation of the interface of a system, formation of concepts, regularities, theoretical formulations and practical realization of a specific problem.

Principle of Consciousness. The principle of consciousness is expressed in unity between the conscious attitude towards the learning activity by the trainees and the understanding of the learning material. This is an important prerequisite for overcoming the mechanical learning of information. The following factors are responsible for the formation of this principle: traineeship; organization of schoolwork; developing critical thinking. Consciousness as the quality of personality is expressed as unity between intellectual, emotional and behavioural activity.

Principle of Activity. The essence of this principle is expressed in the purposeful active perception of the studied matter, its comprehension, creative processing and application. It's based on the respective connection between the subjects in the training process - the active and conscious position increases with the awareness of the goals and activation of the cognitive activity of the trainees [16, 25]. The goals for the preparation of future IT professionals can be decomposed into intermediate and specific learning objectives to have a motivating pedagogical impact on the planning and organization of the learning process. How the learning process is carried out during preparation is essential to the increase in students' motivation to take an active and conscious role in learning. The stimulation of mental activity and consciousness in HCI learning is directly dependent on the methods and techniques used.

Accessibility principle. Convenience is the guiding principle for the didactic transformation of scientific information into educational content in a given discipline. Ac-

cessibility requires full coordination between goals and content; age and mental characteristics of trainees; methods and means of training that enable knowledge, skills and habits to be mastered by the normal stress of the forces for a regulated time [16, 25]. The principle requires the presentation of scientific and practical knowledge to be carried out systematically and consistently, well reasoned, illustrated by the intended study time and the psychophysiological characteristics of the trainees. To successfully prepare future computer science professionals in the area of developing quality interfaces of software systems, didactic accessibility rules formulated by Komensky in the Great Didactics in the 17th century were used [16, 25]: from easy to hard; from the known to the unknown; from simple to complex; from near to far.

4 E-course of HCInterface

In the period between 2013 and 2014, Russe University was working on a project called "Development of electronic forms of distance education at Russe University" with the financial support of Operational Programme "Human Resources Development", co-financed by the European Social Fund of the EU. In the framework of this project, a course called "Human-Computer Interface" was developed for the purposes of training in Informatics and Computer Sciences, allowing future specialists in the field of HCInterface to develop further knowledge and skills in the area.

Table 3 presents a learning topics sequence. These learning topics provide a systematic and comprehensive approach to building knowledge and skills, and ensuring the achievement of professional competence in the field of computer science and informatics.

Table 3. Learning Topics in HCInteraction

N	Learning Topics
1.	Introduction to HCInteraction. Where and how to use HCInterface.
2.	HCInterface components.
3.	Human aspects of the UI.
4.	Cognitive structures of HCInterface.
5.	Interface metaphors and conceptual models.
6.	Design aspects of the UI. Principles and methods of user-centered design.
7.	Instructional design - requirements and usability.
8.	Task's hierarchical and cognitive analysis.
9.	Structural design framework.
10.	Interacting tasks and techniques. Integrated learning design environment.
11.	Design estimation. The estimation role.
12.	Data Collection - Methods and Techniques. Experiments and standardization.
13.	Evaluation Results and Implementation.
14.	Expert assessments.

The main objective is to familiarize students with the main principles, approaches and techniques for designing and developing HCInterface. The main focus is placed on the project building and the testing methods of prototype development and evaluation, as well as on the psychological aspects of the HCInteraction. Students are involved in discussions about the effects of human factors on interface designs and development of applied software; methods and techniques for user-centred and analysis-based structural design of interaction; HCInterface evaluation. After introducing the main points and history of HCInterface, the feature focuses on the components of HCInterface - user, physical and social ways of interaction and the computer interface. Human aspects of the user interface are very significant for feature programmers. Understanding the properties of human capabilities include cognitive ergonomics, usability and HCInteraction. WIithout that knowledge, some applications could create difficulty in usage for cognitively impaired users. A part of the problem is that designers have very less knowledge about human factors [1]. The challenge for system designers, human specialists, and anyone interested in computer design is transoforming 'what can be done' to 'what needs to be done' to meet user needs. At the physical level, this means selecting the most necessary input devices (keyboard, mouse, etc.) and corresponding output devices (video, text, graphics, etc.) to solve a particular task. Here is the point of the interface metaphor and conceptual model of the HCInterface. Students have to get acquainted with the basic concepts and factors in the meaning of interface, icon, command menu; mental models - necessary elements of the theory, types of models, the utility of their use, etc. Design aspects of the user interface are very similar to the software system design. However, they are not the same when designing the human-consumer interaction - quite specific factors should be taken into account, the most important ones being the principles and methods of User-Centered Design. It is a multidisciplinary design approach based on the active involvement of users to improve the understanding of user and task requirements, and the iteration of design and evaluation. User-Centred Design is widely considered the key to product usefulness and usability as an efficient approach to overcoming the limitations of traditional system-centred design. The quality of the software is its very distinctive feature. The principal purpose of using standards and metrics is to standardize the look and feel of a user interface. We certainly want to standardize the various windows and dialogue boxes of a single product, and we may also want to standardize the interfaces of multiple products or systems that people may be using. Besides, we may want to standardize, to some extent, across all products for a single platform such as Macintosh, Windows, or Motif. Standardization facilitates learning and reduces errors by taking advantage of the knowledge users have gained from other products or other parts of your product. In addition to the recommendations, a standard typically includes one or more of the following kinds of information (usually for each recommendation): Rationale and principles; Examples; Exceptions and References. Although measuring usability can cost four times as much as conducting qualitative studies (which often generate better insight), metrics are sometimes worth the expense. Among other things, metrics can help managers track design progress and support decisions about when to release a product. And last, but not least is the point on the HCInterface evaluation process. There are different methods of the evaluation process, such as inspection methods (heuristic evaluations, walkthroughs,

expert assessments, monitoring and control, data collections), user tests (observations/ethnography, usability tests, controlled experiments).

Fig. 1. The home page screen of the HCInterface course

The course aims to build up the knowledge and skills of future specialists in the field of computer science as equipt students with necessary knowledge and skills to build software systems with user-frendly and consistent design. Figure 1 shows the home screen of the discipline's site. This way, the students have access to all resources related to the course of teaching and learning.

There is a proposition for the inclusion of an annotation that describes the overall content and goals of the course education. Every student can become familiar with the curriculum and read a list of recommended reading for additional training. Educational content is organized in lectures, theoretical foundations of human-computer interface and exercises. At the beginning of each lecture, there is an explanation of the purpose and the knowledge that the student will receive after familiarizing with its incorporated material (Fig. 2a). At the end of each lecture, there are raised questions about the acquired knowledge for the self-control (Fig. 2b). Each session begins with a description of the objectives and requirements for theoretical training for the duties. There are suggested solutions for a part of the tasks, and there is the proposition of others to exercise. Under each theme were developed tests for self-control of the acquired skills and knowledge. Every test presents different versions with randomly selected questions. Students may excercise repeatedly to check their level of familiarization with the learning material. The tests allow immediate assessment of the students' knowledge. Their significance in the development and motivation of the learner is indisputable. The grades of the tests are also a useful resource for teaching staff. By taking them into account, teaching staff can address students' individual problems, and better manage the learning process. Grades also have value in terms of data collection and statistical evaluation of different parameters for the detection of positive trends and the pursuit of their betting. Not least, the grades are used for measuring the quality of the educational process.

Fig. 2. a Beginning of a lecture with listed benefits

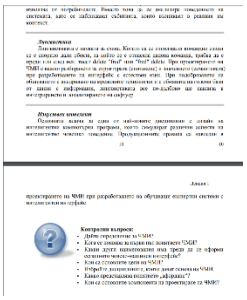

Fig. 2. b End of a lecture with selfcontrol questions

The course content involves the development of a term paper. The course site page presents a publication of methodological guidelines and a sample term paper to support students' work. The home page provides a reference to the essence of the questions which students must be prepared to answer in order to pass the course. In favour of the successful course training the following possibilities can be found posted on the webpage: contact details of the teachers responsible for the discipline; forum; chat.

Up to this moment there are more than 300 students trained in the course "Human-Computer Interface". They comment to have found its contents especially useful, and indicate the advantages of the possibility of distance learning. Personal orientation is a top priority for the course, which is intended to equalize the levels of knowledge and skills.

The performance by years is presented in Table 4. The results of the trained students from 2010 to 2018 have been tracked. It could be seen that since the creation of the HCInterface course and its use in student education (2012-2013), the final results in the discipline have improved significantly.

Table 4. Students' yearly performance

Study year	Number of students	Average grade
2010-2011	39	3,87
2011-2012	51	3,8
2012-2013	40	4,47
2013-2014	36	4,28
2014-2015	35	4,28
2015-2016	41	4,15
2016-2017	15	4,25
2017-2018	20	4,25
2018-2019	26	4,38

5 Conclucions

Besides optimizing the learning process and increasing its efficiency, there is an additional benefit to such education - the knowledge obtained in the process of training and new technologies usage affects all further social and life skills. Achieving high levels of competence suggests a methodological, well-planned and organized learning process, based on steady knowledge.

Undoubtedly, at the end of their university experience, students should present a level of proficiency with knowledge and skills in the human-computer interface. To provide purposeful and effective learning methods that results in a high level of professional competence, the presence of extensive knowledge is imperative. This is achieved by defining the necessary basic units of knowledge and by bringing them together in the content of the specialized course. This will ensure availability and the relatively equal level of students' knowledge and skills. Obtaining necessary knowledge of students majoring in Informatics and Computer Science professional area, it should be achieved through distance learning, as it provides opportunities for individual approach and corresponds to the modern trends in higher education.

Using Web lectures to present lecture material before class allows for more time from the course to be allocated for practical learning, rather than just listening and observing material. The use of electronic forms of coaching enables, on the one hand, the intensifying of the training and, on the other, the determination of the specific required pace of the trainees depending on their abilities. This enhances the quality of training, as evidenced by the data presented.

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