The Medialogy as an example of interdisciplinary studies in the IT sphere for adaptation experiences into Saratov State Universities learning process

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Abstract

At the same time as the complexity of problems in a global perspective the technological development is open for many new possibilities. It is also clear that the society needs a new type of specialists, who are able to work with complexity of problems in an interdisciplinary way. It is not enough to have specialists focused strictly on one area. The complex problems and the new technological problems will need specialists with a new type of skills. Future technological specialists will need qualifications within specialist areas as well as interdisciplinary qualifications which are necessary when analyzing and solving complex problems. In fact, a new type of education will be required. The question is: Can it be included in existing program or be a part of a new program?

The paper presents experiences from implementing interdisciplinary principles in the system of Saratov State University, Russia. We have designed and implemented principles from the interdisciplinary education, Medialogy, Aalborg University Denmark. We have organized a curriculum in Saratov University, Russia using a dual-education – main classical Maths and CS educational program and additional educational program Computer Graphics and Web Design using the ideas from interdisciplinary education – Medialogy, adapting the experience AAU in SSU.

As a result, we synthesized curriculum on the principles of the interdisciplinary education.

Introduction

The rapid development of information technology is constantly generating new challenges for the education system. The continuously growing demand for high-quality graduates, who are qualified in the field of programming, information technology and telecommunications, will result in new qualifications, which make the candidates able to work with more and more complex problems [1 – 5]. The education system should quickly respond to the changing technological landscape and adapt to the needs of the labor market, by developing a new curriculum [2].

Information technology is becoming a part of ordinary people's everyday life. Electronic services are actively developing. High-tech devices become easy to receive e-services for the average consumer. Modern Europe and the United States are the area of non-cash (electronic) settlement and widespread availability of information transparency. Even small shops have a website that contains information about itself and allowing a customer to order a goods or

services. Large companies and public bodies publish detailed reports on their websites [6] "Today we can say that the development of computer technology not only creates a new technological system, but new social reality", — V. L. Inozemcev concludes [7, p. 57].

Technologies come into everyday life. That is why technologies have to be accessible and understandable to ordinary people. There is the need for employees having skills in the field of IT as well as in the field of humanities like perceptual psychology, human computer interaction design and multimedia. These competencies are already in demand by companies in the area of computer games for both entertainment and edutainment, mobile phones, television, films and other companies dealing with new media. Only a few universities can meet this challenge: most of the modern educational standards aimed at preparing IT graduates in general, or graduates who are specialized in one area (such as IT, information security, communications, etc.). Saratov State University is one of those few universities. But not every graduate has the required set of competences.

The problem is that the society needs a new type of specialist, who is able to work with interdisciplinary problems. This is not a specialist with several specializations in different areas. In fact, a new type of education is required. The question is: Can it be included in existing program or be a part of a new program? Which competencies are needed and how do we get them at Saratov State University?

The experience of Saratov State University (Russia)

Currently the Mechanics and Mathematics Faculty at Saratov State University named after N. G. Chernyshevsky successfully educate specialists in the field of IT. Students of different learning programs successfully participate in competitions such as the ACM International Collegiate Programming Contest, International Student Olympiad "Business&Management", Russian Federal Olympiad on Applied Informatics, Open Volga Mathematical Olympiad and other. Graduates of basic education programs are successfully employed in large international and Russian companies.

Russian educational system has main educational programs (bachelors and masters) and additional educational programs. An additional education is based on a bachelor program and it consists of only special courses, forming a specialization in a specific area. So an additional program does not have common basic courses of a Bachelor degree course. Only graduates (or students) of the bachelor program can be enrolled in the additional educational program. But if a student studies a bachelor program and he/she is expelled, he/she will be expelled on additional program automatically.

The Faculty of Mathematics and Mechanics at Saratov State University started teaching an additional educational program "Computer Graphics and Web Design" in 2003. The study program is implemented for students enrolled in one of the bachelors programe such as "Applied Computer Science", "Mathematics and Applied Computer Science", "Mathematics" and "Mechanics". The main educational program (bachelor program) develops the needed general and specific IT competencies.

If you are a student studying the additional program, you joined additional classes that do not overlap with main classes. The additional classes develop art and media skills. Duration of the additional program is 4 years and is equal to the duration of the bachelors program.

Therefore, we can name it a "dual" education. The profile of the graduates is interesting in the context of this paper.

Those graduates have a basic education within the mathematical field and further qualification in the field of computer graphics and web design. In fact, the parallel studies of main and additional programs can be seen as an interdisciplinary education.

The integration between disciplines of main and additional programs is task-based. For example, one of the tasks of Web-Development discipline is to produce a simple content management system (CMS). Students need to know database theory. The Database Theory is a discipline of a main educational program. So the students have already this knowledge, and they can use it. Web-Development discipline focuses on aspects of usability and design.

Any student of the main program may also be a student of the additional program, but not everyone is following the additional program. That is why disciplines of the main educational program cannot use the knowledge of the additional educational programs.

During the first study year in an additional educational program students learn the basics of the theories of composition and colors, hypertext markup, typography, and the process of Web sites developing. A special place in the structure of the disciplines of the first year is a course "Introduction to Specialty". Students will meet and interact with representatives of a number of professions related to computer design. Students have the opportunity to get an overview of their possible application areas directly from the industry. The second year is dedicated to developing web sites and applications (back-end component of web applications), raster graphics, the basics of modern design and a design of advertising. The third year is dedicated to developing web sites and applications (front-end component of a web applications), the project management of a web site production, vector graphics as well as 3D graphics and design of computer games. The fourth year of study is devoted to computer networks, operating systems, maintenance of web sites, computer animation and interior design.

So the structure of the additional program consists of a few vertical series of disciplines. Illustrated in table #1.

Semester	Topics (by series)		
	Web Design and Programming	Instrumental	Subject Areas
1	Introduction to Web Technology	Introduction to Specialty	Theories of Composition and Color
2	Hypertext Markup	Polygraphy and Text Design	
3	Requirements Analysis and Design of Web-sites and Applications	Raster Graphics	Modern Design and Computer Graphics
4	Web-Development I (Databases and Server Programming)		Special Course #1 (Advertising design)
5	Web-Development II (Client Programming)	Vector graphics	Special Course #2 (Games design)
6	Web-Development II (Group Projects)	3D graphics	Special Course #3 (Design of User Interface)
7	OS and Networks		Special Course #4 (Interior Design)
8	Maintenance of Web-site and Applications	Animation	Special Course #5

Tab. 1. Additional education curriculums structure

The conjunction of the "dual" education programs forming graduates with unique competencies. They can find job in a traditional IT sphere or on the border of computer science and design, such as computer games character animators.

The specialists of Applied Informatics Department have developed a bachelor program with specialization in computer design according the experience of the additional educational program "Computer Graphics and Web Design" in 2012 [12]. This is integrated in the curriculum but it looks like a "dual" education.

The experience of Aalborg University (Denmark)

Medialogy is an education started at Aalborg University in August 2002. The goal of the education is "to develop problem solvers in a digital media age independent of tasks" [8]. This goal is achieved by merging creativity, arts and technology through the development and cross-combination of areas and topics within the field of engineering technologies, computer science, psychology, sociology and arts. Such areas have until recently been kept apart by conventional standards. The education is concerned with the current and future needs of society, culture, industry, hardware and software. The purpose of the program is to provide students with a solid foundation in areas within new media comprising both technical and creative aspects. Students graduating in Medialogy will be able to integrate and combine different fields of new media technologies [9].

The students and graduates of Medialogy seek to maximize the involvement of the human senses in its interaction with the machine, and information systems. Good examples of solutions of such problems can be: technologies of "immersion" in the world of a computer game, combining a variety of artistic techniques and the use of audio-visuals, tactile senses (for example, the resistance of the joystick-steering when entering a corner at speed in the driving simulator) etc. Another example of technology adaptation of children with disabilities (for example, children who have hearing impairments or dyslexia) using the learning process in specific designed games. The graduates will become specialists within human-computer interaction in all areas of human activity connected to new media. .

 Medialogy is an interdisciplinary education. The main challenge is the design and planning of curriculums on the interdisciplinary field of study according to current needs and trends in the technological development and the creative sphere [10-11].

The terms interdisciplinary and crossdisciplinary or multidisciplinary are often used without considering their meaning. It is important to have a clear definition and understanding of those words when being in an environment trying to establish a common understanding of a new education with a new combination of disciplines. Rolf Nordahl and Lise B. Kofoed in the paper [9] suggest using the definition proposed by Meeth in 1978. Observing the confusion in defining what an interdisciplinary education is, Meeth proposed a hierarchical classification [10].

1. At the bottom he placed *intradisciplinary* studies i.e. studies composed of a single discipline.
2. *Crossdisciplinary* studies i.e., studies in which one discipline is viewed from the perspective of another. Crossdisciplinary studies are relatively easy to establish

according to Meeth, since they allow faculty members to remain in their own disciplines.

3. *Multidisciplinary* studies are placed at the next level where each will offer their own viewpoint, but not necessarily with any integration.
4. *Interdisciplinary* studies in which the attempt is to integrate several disciplines which allow solving particular problems.
5. The highest level of integrated studies is *transdisciplinary* studies.

This approach goes beyond disciplines, since they start from a problem and using problem solving, they bring the knowledge of those disciplines which contribute to the solution [10]. As also argued by Meeth, transdisciplinary studies are hard to design, since they require highly prepared and intellectual mature faculty members. The question is if the Medialogy at the current state can be named a transdisciplinary program.

The term interdisciplinary education is used by Aalborg University and Medialogy. The Medialogy education follows the Bologna model of dividing the curriculum in 3 years for a Bachelor degree and 2 years for a Master degree [8]. During the first year of the bachelor degree, students are exposed to topics such as animation and graphic design, introduction to problem based learning, introduction to programming, interaction design and human computer interaction as well as Mathematics. During the second year of the bachelor degree students are exposed to topics such as A/V production, human perception, computer vision, object oriented programming, sound and music computing and experiment design. During the third year students are exposed to topics such as computer graphics and screen media, interactive systems, media psychology and sociology. The structure of the Medialogy curriculum is illustrated in table #2.

Semester	Topics	Project
1	1. Problem based learning in Science, Technology and Society (5 ECTS) 2. Animation and Graphic Design (5 ECTS) 3. Introduction to Programming (5 ECTS)	Project theme: (15 ECTS) Design from both side of the screen
2	1. Mathematics for Multimedia Applications (5 ECTS) 2. Physical Interface Design (5 ECTS) 3. Interaction Design (5 ECTS)	Project theme: (15 ECTS) Designing from both side of the screen. Interactive design – human computer confluence.
3	1. A/V Production (5 ECTS) 2. Image Processing (5 ECTS) 3. Perception (5 ECTS) 4. Procedural Programming (5 ECTS)	Project theme: e (15 ECTS) Human senses – digital perception
4	1. Sound and Music Computing (5 ECTS) 2. Design and Analysis of Experiments (5 ECTS) 3. Object Oriented Software Engineering (5 ECTS)	Project theme: (15 ECTS) Sonic interaction – design evaluation
5	1. Computer Graphics Programming (5 ECTS) 2. Computer Graphics Rendering (5 ECTS) 3. Screen Media (5 ECTS)	Project theme: (15 ECTS) Audio – visual experiments
6	1. Real-time Interfaces and Interactions (5 ECTS) 2. Media Sociology and Psychology (5 ECTS)	Project theme: (20 ECTS) Interactive System Design

Tab. 2. The Medialogy curriculums structure

When finishing the Bachelor education students can handle several aspects of media technology and are able to solve problems in an interdisciplinary way [9].

Adaptation of Aalborg University experience into Saratov State Universities learning process

Experience of the implementation of additional educational programs shows that "dual" educated graduates from Saratov State University are successful and they are in demand on the labor market, because they have extra knowledge. However, the "dual" education (main and additional) makes life for students more complicated. Those students have less free time and, consequently, the time for preparing and self-study is reduced, which in turn may affect the quality of education in general. Furthermore, "dual" education is not the same as interdisciplinary education. We formed competencies by "dual" education, but there is an area of needs on the labor market, which is not covered by "dual" educated graduates, which is illustrated in fig 1.
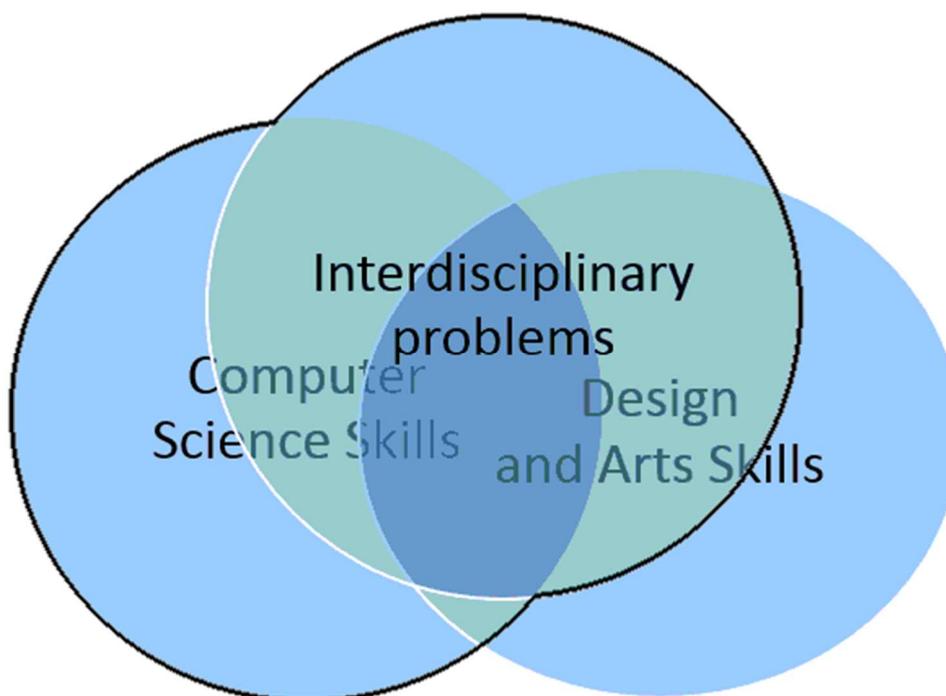

Fig. 1. Areas of labor markets within IT needs (is marked with the bold line)

The "dual" education did not solve the problem posed in the introduction of this paper. So the problem still have not been resolved. We have to form interdisciplinary skills. Therefore, it is necessary to develop the main educational program and implement the principles of an interdisciplinary education.

Implementation of the program "Medialogy" is a unique example of an interdisciplinary education, producing specialists within a new knowledge area, knowledge of which will only increase over time. This program is an example of a qualitative answer to the challenge of society to the education system which has been formed in Europe and the U.S., and which is in Russia now.

Analysis of lessons learned, Aalborg University and Saratov University shows that Saratov State University has built a complex of "dual" education that combines main and additional education programs. So graduates have the similar set of competences as bachelors who studied Medialogy. However, the experience of studying the curriculum of Medialogy and of the Danish colleagues gives a clearer picture of the integration of different subject areas and how the students learning process ended with the competence to solve complex problems in an interdisciplinary way.

1. The Medialogy is an integrated Bachelor program
2. The Medialogy program is designed to prepare the graduates working in a team in a company.

The development of the experience of Saratov University with Danish colleagues lead to the organization of the relevant Bachelor program. However, none of the areas implemented in The Mechanics and Mathematics Faculty of SSU does not fit fully in order to form the complex competencies which have a "dual" SSU graduates and AAU Medialogy graduates. We explored the federal state educational standards of the Russian Federation and we found the standard 036000 "Intelligent systems in the field of humanitarian" most appropriate for this purpose. The Federal Classificatory assignments the program to the enlarged group of standards 030000 "Humanities" but it approaches for development of the IT specialists too because the federal educational standard is prescribed requirements for the results of study [14, § 5.2]:

1. Able to use the basic laws of the natural sciences in professional activities, apply methods of mathematical analysis, logic simulation, theoretical and experimental research in computer science and the humanities
2. Able to reveal the nature of the problems that arise in the course of professional activities, to attract them to appropriate solutions for mathematical apparatus and information technology.
3. Ready for organizational and managerial staff working with small work groups.
4. Able to develop new programs and system interfaces, composition, compose necessary technical documentation.
5. Able to develop and modernize the system using databases and linguistic software.

The requirements for the structure of the program [14, § 6.3] demand the obligatory presence of a series of mathematical and natural sciences (such as mathematical analysis, mathematical logic, mathematical linguistics, discrete mathematics, theory of algorithms, databases, information systems and so on), and a series of humanities (sociology, philosophy, etc.). As part of this standard the Bachelor Program will be most close to the profile of the graduates of the "Medialogy" in case of including disciplines in courses about psychology of perception, as well as special courses, such as "Fundamentals of the theory of composition and color theory", "Raster Graphics" "Development of web sites and applications", "Fundamentals of modern design" and others, as well as the experience of teaching which is already available in the implementation of additional educational program "Computer Graphics and Web Design".

If the construction of the bachelor program "Intelligent systems in the humanitarian sphere" satisfies those conditions, the graduates will possess a set of skills of "dual" graduates'

competencies. In this case, the undisputed advantage is that these competencies will be formed within one educational program, not two parallel programs. In other words, students will have more time for self-study, and the classical academic approach combined with an interdisciplinary approach will allow the student to form an individual educational trajectory deep into the areas according to their interests. There is a "flip side" — the effects of time and getting complex results will get a price which is getting less deeply into the special mathematics or humanities areas. However, the value of such graduates is their interdisciplinary understanding and work methods. In addition, the graduate will possess the competencies to be able to continue education in-depth in a special scientific discipline independently, if he/she will finish with good results. An example of such competence can be "The ability to acquire new knowledge in the field of contemporary problems in science, engineering and technology of computer science, humanitarian, social and economic sciences" [14, § 5.2].

Summary

Given the experience of the SSU and the AAU, we can build a main educational program (bachelor program) based on the federal educational standard of the Russian Federation and it can be built on the principles of an interdisciplinary education. We can see that it is quite possible to solve this problem with the use of the standard 036000 "Intelligent systems in the humanitarian sphere" with a "Medialogy" profile. The most difficult problem is to build an interdisciplinary (in the meaning of Meeth) teaching methodology. It is possible that getting the methods and new combination of skill-sets also requires a special curriculum structure.

In this paper we have found a "frame", in which we will be able to combine the experience of SSU and AAU. The "frame" is a curriculum integrating computer science, maths, design and arts competencies. Nevertheless, it is a first step only. SSU accredited bachelor program "Intelligent systems in the field of humanitarian" in September 2013. Next step we will plan and establish complete educational approach forming interdisciplinary study processes and interdisciplinary competencies using the understanding of Meeth [10]. Interestingly it is also seen as Problem Based Learning pedagogical approach. Adaption of this will be the focus of future research.

A curriculum has been synthesized with the common idea of AAU curriculum structure. It consists of a several blocks of disciplines which have a common theme. Each semester includes one of this block and a few of secondary disciplines required by study regulation. This program will start in 2014-15 acadeemic year and we'll get a good feedback. The feedback will show fusion problems. Feedback analysis will give materials for correction.

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