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PROJECT-BASED APPROACHES AND RESEARCH AS PEDAGOGICAL TECHNOLOGIES IN HIGHER EDUCATION

The article explains some practices of Project-Based Aproaches and Research used in Computer Science Department in Varna Free University "Chernorizets Hrabar". The main emphasis is to build up an environment where, once developed, good practices can survive and develop and give students the possibility to choose in what community, project, and research to be involved.

***Keywords**: Project-Based Approaches, collaboration, research, competency, entrepreneurship, higher education, computer science education.*

The Project-Based learning in general has a long history and a wide variety of usage. Today the most widely used Project-Based Approaches (PBA) methodology is that of Intel (http://www.intel.com/education/video/pbl/content.htm). It is mainly used for high school students but it can definitely be adapted and customized for implementation in every educational environment.

The PBA is leader of the idea of developing 21st century skill that includes the ability to identify an informational need, and then to find, collect, organize, evaluate, and use the information to create new ideas and solve problems.

It uses holistic approach and involves higher-order thinking like: applying, analyzing, evaluating, and creating.

Some of the benefits of PBA are the evaluation process that is mainly based on the rubric development, negotiating their content with students. The rubric is actually a description of the criteria for assessing student work or processes with levels of achievement for each criterion.

In modern professional development courses for teachers developed by Microsoft, “Partners in Learning Professional Development”, a special emphasis has been put on collaboration rubrics. The possibility of collaboration is grouped in these cases:

- Students are required to work in pairs or groups;
- Students have shared responsibility;
- Student makes substantive decisions together;
- Students work is independent.

A very powerful and supportive instrument of the PBA course is the Engage community (http://engage.intel.com) by Intel, where teachers collaborate and share resources, ideas, practices. The network of similar importance is pilnetwork by Microsoft (http://www.pilnetwork.com).

Educational programs are also developed by Cisco, Adobe etc

Every particular policy of transforming education with ICT has the following elements:

- Methodology;
- Technology;
- Expertise;
- Community.

Their similarity is based on their common bases like 21 century skills, Unesco ICT Competency frameworks for teachers, ISTE standards etc.

So "Raising the bar" in teaching and learning on high school level raise some questions about the quality of teaching and learning in Higher education.

Widely used in PBA is constructivism, where people can create their own knowledge and meaning. It is suitable not only for schools but also for university level.

A classification of m-learning is represented by Yeonjeong [3].

Some specific facets of Higher education are the opportunities for collaboration with the industry, innovation and investment [5]. So the methodology in HE is Bussiness like or technology based (like e-learning and distant education) initiatives because of the trend of internationalization in HE and the mobility of students and lecturers.

But a lot of practices concerning entrepreneurship are applied at school level (Junior Achievements, Training Companies, ets). A quite interesting challenge is the competition Technovation, where teams of girls not only create mobile software with App Inventor but also prepare business plans for the application.

A quite positive idea of another methodology is the Enquiry-based learning. It is developed to support science learning and to prepare students for participation in Intel ISEF competition. This is mainly suitable for science educators.

The basic deficiency of such policies, initiatives is their discontinuity.

The only thing that unites them is the usage of the same technology set of tools for a particular period of time.The educator and the learner communities are not separated because they are live in one community.

As for the career development fashions these days a good illustration of the type a person can be a particular shape of a person [1].

I-shaped people types are those that have expert domain skills in one specific area. A researcher who has spent their entire life in science in one area is more like an I-type person. These are the people that can solve a problem like a ninja – focus and specificity.

Hyphenated people type are those that have no specific domain skills of full competence, but have a broad range of skills across domains. Examples of hyphenated people types include career project managers or general managers at large organizations who have never built anything but a project plan.

T-shaped people types are those that not only have the strength of a specific domain area (i.e. the I-shaped), but a broad set of other domain skills too to collaborate and build things with others.

If you are exceptional with two domain specific skills, and have broad cross domain skills as well, you fit in the A-shaped type.

There's even a book on the subject of T shaped people sparking creativity and innovation.

The first reason for the above is to figure out what kind of an organization you are in and where you'd be better suited to be at. Startups for example need to have lots of T-shaped people because there's no place in a startup for a hyphenated person – dollars are scarce, time (to market) is usually short, and if you want to attract outside investment, you better have an A-class team. Stellar professional services firms too develop their teams this way – where you have a lot of domain experts with specific industry knowledge, sometimes in more than one area, and can operate across domains [1].

Guardian Higher Education Network is dedicated to those that work in and with higher education recognises and giving information about teaching excellence practices on university

level like: Dynamic Laboratory Manuals (University of Bristol), London School of Economics or Plymouth ebook project etc.

In 2012 in Bulgaria a group of 29 expert representatives of software companies and organizations that take part or support the development of the software industry carried out a research on the requirements of software companies in Bulgaria to the education and qualification [6].

This document contributes to the Bulgarian software industry in the citizen initiative "Dialogue for the future".

There is a discrepancy between the present methods of teaching and evaluation of knowledge (tests and diplomas) and the actual qualities, knowledge and skills needed for a successful professional realization. We recommend implementing a competency approach, which integrates knowledge, skills, attitudes/values, and behaviour experience leading to good performance. Therefore the traditional academic model of teaching must be transformed into a competency model of teaching and evaluation of the educational results [6].

The software industry and society as a whole need independent thinkers who can actively apply concepts and their own creativity, who are willing to adapt and develop sustainably. Individuals with social and communication skills who are prepared to achieve common goals through teamwork.

These and other important characteristics are analyzed and defined as 18 basic cognitive emotional and 32 comprehensive competencies, loosely grouped as personal-social, communicative, interpersonal, modelling, problem solving and process-organizational. In addition we define linguistic (Bulgarian, English, other language and communication) and cultural historical competencies needed for the successful integration into world economy.

These competencies are the core of the new exigencies for education. They must be built and integrated horizontally - in all subjects, types of training and educational activities; and vertically - the pre-school year at kindergarten to the Master's degree at university and sustainably throughout the entire life. This calls for a new "architecture" of education, one that integrates basic and complex competencies with subject training, while hands-on activities ensure accumulation of practical experience, and establish habits, attitudes and values [6].

Problems of higher education:

31. a large number of universities with the low quality of education;

32. finding system leading to a focus on quantity, lowering the quality and unreliability of the evaluation;

33. academic autonomy interpreted as a denial of responsibility to the public and refusal of necessary changes.

34. a large number of ageing professors "reading" lectures with inadequate content;

35. curricula consistent with the available teachers instead of the actual needs of society or current level of the discipline;

36. Serious waning of the interest in "difficult" scientific and engineering disciplines in favour of the "easy" economic and social disciplines.

37. Diplomas do not ensure the required level of knowledge, skills, values, attitudes and acquired experience in the respective fields;

38. Inadequate English language skills;

39. public order for majors is not defined by actual business or social needs, nor by state strategies (if there are any);

40. curricula in many disciplines take no consideration of the actual business and social needs, nor of the scientific achievements worldwide.

41. students do not acquire the necessary practical experience, internships are fictitious;

42. many of the teaching methods are inadequate and do not build the necessary "soft" skills like teamwork, organization, communication and leadership [6].

The following types of competences are distinguished:

- behavioural ("soft") – they define the behaviour and the attitude for achieving high quality results;
- technical ("hard") – they include specific professional knowledge and skills for the successful implementation of occupational roles;

On the other hand, there are:

- general / basic competencies - these include the common competencies, which employees must possess and demonstrate regardless of their position.
- specific competencies - related to a particular professional role / function [6].

Therefore, the main goal of the system of education must be in the unlocking, developing and establishing these cognitive competencies fully and permanently as habits, attitudes and values.

Masters' degrees must be updated at the highest world level with consideration of the competency models and focusing on overcoming the basic shortages in:

- technological aspect - leading concepts, architectures, technologies;
- process management - individual, team, project, organization;
- business in the digital world - digital transformations, ecosystems.

In 2012 a special organization supporting women in IT was created in Bulgaria – BCWT. Its goal is to involve and assist the establishment of more women in IT in general.

We think the missing element is the lack of clearly defined connections between these communities, structures and organizations. That’s why the results are unpredictable.

The basic problem in a typical Bulgarian style is the lack of mutual agreement and trust.

The solution lies in developing vivid partnetships and networks of active and adaptive proffessionals.

For example we created a Visual programming group of volunteers called ScratchBG and since 2010 and we have been building a network of different organizations and professionals who participate in different roles.

At the moment this network consists of different type of organizations: universities (Varna Free University), high schools (High School of Mathematics), companies (providing hardware for educational purposes) and of professionals, parents and young people (high school and university) students.

The initiatives we are working on aim to organize events, supported by necessary trainings, educations, certifications and also to connect our efforts with the existing good practices and to receive improvement from other professionals.

Our latest initiative is the “Mobile application” session for students from universities and schools in which they can demonstrate their own mobile applications. This session is a part of the National conference with international participants that is organized by the Minucipality of Varna in October 2013.

The same session is a motivation to work in teams creating applications that can be used in representation or in competition also in training companies, Junior Achievements and Startup companies.

Our aim is to put such practices earlier. That’s why we are thinking about similar extracurricular activities where students can participate and develop multiple competencies.

At university level it is not quite common to do this with students. A lot of university lecturers think that this is"not for university level". However, our every day life in university shows that this practice is international and we are ready to think about its implementation.

That's why we are seeking expression for our initiatives abroad and hope for some of them to find after years adopted in Bulgaria.

One good explanation for general lecturer in university is that if students in primary and high school level are used to use IWB digital microscopes etc they will see the university as some sort of a history museum. That works in order to persuade colleagues to work in digital environments.

Up to now the most widely used modern methodology or pedagogy is distance education and the conception of this in every university is definetely IT dependant and HR dependant.

Our basic idea is to continue the good practices from school level and to think about adaptation and continuation at university level.

We are doing a lot of extracurricular work with students in the form a seminar named AHAdemy ("aha" +academy) where we meet monthly with students from all specialities in the university and people from software companies and some teachers from Varna on a particular topic of Web design.

Some special seminar with international participation is also done (Master Classes).

Technology driven educational practices are new for everybody regardless of their age. (from young pre-school children, teenagers, university students, teachers and university lecturers)

Our observations show that every student is interested in sensor devices like Kinect or Robotics and only the level of maturity in life and on profesional level is different.

When trying to teach students difficult concepts we find they are not familiar with basic concepts. At the same time a lot of concepts are clear and not difficult to be represented earlier.

So a strategy to reduce difficulty is to develop presemester activities, some kind of introductory activities in which some basic concepts are learned in a simple way.

The PBA is a suitable for organization of such kind of activities.

The same can be used with students from other specialities. For them such a course is a technology-based course for research.

So we suggested to special kind of schools with SEN students to learn visual programming in order to create their own educational games and resources for particular learners.

The first step in that is to take two courses on adapting such resources with kindergarten teachers.

The adaptation on these games is on the following levels:

- Images and sound adaptation;
- Reducing the complexity;
- Raising the complexity.

An educational game or software in general is a good opportunity for a PBL topic.

In computer science majors in general improving the quality in teaching/learning is made in two flows: the first is to prepare for the near future (brave changes) and second to improve the current process "on the fly" by embedding new vivid extensions in it.

Some examples and details about our experience in major Informatics is the following:

Current curriculum includes

I. Programming I., Programming II. (C/C++)
II. Data Structure and Algorithms (C++, Java)

III. Programming Techniques
IV. Software Technologies
V. Software Development

The motivation of students drops in Programming I.

The structure of lecture/seminars is not effective.

For the next academic year we have two specialities:

- Informatics and Computer Sciences;
- Design Computing.

Students will start with general (common) disciplines. That's why we want to diversify the content in order to create comfortable environment and let them feel that they are in the desired area/major from the very beginning.

So one of our decisions that will cost us small efforts is to develop several versions for the exercises of the course where the content of the problems for practice is different.

Another improvement is to put to the Current Curriculum some Extensions

I. Pre I. Visual Programming (Scratch, Scratch 2.0)
II. Programming I., Programming II. (C/C++)
III. Data Structure and Algorithms (C++, Java)
IV. Programming Techniques
V. Software Technologies
VI. Software Development

We have the experience to try to make Pre I. with skills for learning content, time management and introduction to career development.

In academic 2013/2014 the Pre I. will take into consideration the previuos experience and will also implement new ideas.

Starting to learn visual programming is difficult that's why some efforts to do this in a funny way are a good starting point.

In this Pre I. we are creating games for different purposes. They could be educational, arcade, psycological etc.

In Pre I. During Programming I. we can continue using Scratch in order to support emotionally the education process. This will be a motivation for deeper reasoning the computer science topics. We have such experience last year with 5^{th}, 6^{th} grade students preparing them for national contests in competitive programming.

From this academic year we have the possibility to use some devices that are easy to use with Scratch. They are:

- MS Kinect – for building natural user interfaces;
- LEGO WeDo – for building movable parts developing constructive skills;
- mOway Robots – for controlling robot with sensors;
- Raspberry PI – for controlling sensors.

All of these devices are suitable for research work, future projects and deepening knowledge.

For example, MS Kinect has its own SDK, mOway Robots can be programmed in C and Assembler, and Raspberry PI can be programmed in Python.

The goal of the research is to be invovled in PBL work.

The programmable devices mentioned earlier can be used to collect data, students can develop algorithms for their own experiences.

They can use other ways for experimenting. They can use mashable technologies, some semantic technologies, their own mobile applications, etc.

We have demonstrated all of these on May 19th in Varna Sea Garden in one public event organized by Varna Free University and Natonal Astronomical Observatory and Planetarium in Varna.

Our students can be mentors to kids in such projects, which is very useful for developing their soft skills.

The idea also is to encourage students to be teachers and take the possibility to graduate not only in Informatics, but also as teacher in Informatics and Information technologies with taking additional courses.

Some of the activities where university students have been involved with kids in workshops, summer camps are recognisible as school classroom practices. After participating in a team students usually say they want to have and lead their own team.

So, we are searching dynamically and we found our different helpful activities, possibilities where students have different roles from learners to mentors, instructors and lecturers.

In courses in Data Structures and Algorithms it is appropriate to use lists and implement with them data structures like sets, stacks, queues.

The topic concerning recursion can be implemented using BYOB or SNAP and also Scratch 2.0 environment.

The visual programming languages can support also software development practicums. One idea that we've been applying in recent years is to use Scratch in order to create a prototype of future software project in order to test GUI.

Using such methods to engage students in learning process in general

We think using PBL and visual programming tools works towards motivation and engaging students. Engaging can be short term or long term. To make the process sustainable we need long term engagements supported by online collaboration tool.

A lot of new initiatives we are currently raising at the university can be used as elements for its internationalization. Such program is being prepared now. It focuses on gamification for business and educational needs. Such initiatives can be new master programs, new Master classes, new summer workshops, etc.

A good starting point for students in computer sciences to work in collaboration with other students from different specialities is the discipline Social Network Analisys.[2]

Such a discipline, with a different content, is represented in some masters programs and in computer science programs. An important fact is that students have an important tool to design their research in their hands and, if this is with local emphasis, it is quite suitable to be organized in PBL style.

In conclusion, a large set of possibilities for research in PBA style persists and flows down, so we need to select dynamically the most appropriate challenge, people and partners involved in it for the moment. A lot of new partnerships could be and will be established. The projects with local importance should be presented to the authorities in order to find financial support.

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ПРОЕКТНО-ОРИЕНТИРОВАННЫЙ ПОДХОД И ИССЛЕДОВАНИЯ КАК ПЕДАГОГИЧЕСКИЕ ТЕХНОЛОГИИ В ВЫСШЕМ ОБРАЗОВАНИИ

Статья раскрывает некоторые подходы и исследования , которые находят применение в отделе информатики Варненского Свободного университета имени "Черноризец Храбар ". Основной акцент делается на создании окружающей среды, в которой развитый метод (подход), подтвердивший свое право на существование и развитие, может предоставить студентам возможность выбора подхода в зависимости от вовлечения в сообщество, проект, исследование.

Ключевые слова: *проектирование, подход, сотрудничество, исследование, компетентность, предпринимательство, высшее образование, образование информатики.*

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ПРОЕКТНО-ОРІЄНТОВАНИЙ ПІДХІД І ДОСЛІДЖЕННЯ ЯК ПЕДАГОГІЧНІ ТЕХНОЛОГІЇ У ВИЩІЙ ОСВІТІ

Стаття розкриває деякі підходи і дослідження, які знаходять застосування у відділі інформатики Варненського Вільного університету імені "Чорнорізец Храбар". Основний акцент робиться на створенні навколишнього середовища, в якому розвинений метод (підхід), що підтвердив своє право на існування і розвиток, може надати студентам можливість вибору підходу залежно від залучення у співтовариство, проект, дослідження.

Ключові слова: *проектування, підхід, співпраця, дослідження, компетентність, підприємництво, вища освіта, освіта інформатики.*

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