Bypassing curricula constraints by means of ICT

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Abstract

The education system of Moldova acts by the inertia of a traditional framework, which regards the education as a production process. The production of prepared and disciplined staff is done in accordance with standardized educational processes. This approach probably fits perfectly into a society which undergoes full industrialization, but not into a post-industrial one, which faces big social and economical challenges. The need of changes in the society is entirely reflected in the education, where the curriculum emerges as a transformation of an effort (individual and collective) into *competences the society needs*. What can be done if this transformation function has different economic, social, cultural and political constraints, that diminish the development of responsibility, creativity and critical thinking, but also the ability of *an individual* to work in a team? The goals of any actual program aim for these characteristics, necessary to each employee. But, these being not put into practice, not being part of the *learning model*, by no means can be fully reached. Therefore, a new learning model is imposed: a restructuring of the study program based on interdisciplinarity (attained by real-life problems of the society), flexibility (offered by information technologies) and freedom (to individually choose the problem in accordance with one's abilities and interests).

Keywords: Curriculum, learning model, ICT, PBL

Bypassing Curricula Constraints By Means Of ICT

1. Premises (What Is The Problem?)

Moldavian education system as a whole, and higher education specifically, was mainly a heritage of the Soviet education systems, based on the classical approach: teacher - centered pedagogies. In the last two decades, considerable effort was put into adjusting our national education system in accordance with the international, mostly european standards. TEMPUS programme was the first to be implemented, as early as between the years of 1990 - 1994 in its first phase, later being consolidated in four phases, from 1994 up to 2013.

Today, moldavian higher education is part of the Bologna process, meaning that our higher education is compatible with the european one, so our students and staff have mobility opportunities in such partner programmes as Erasmus or Erasmus+. Yet, it wouldn't be fair to say that moldavian education system fully complies with the modern european systems, as the study process isn't tailored to the needs of each student taken apart.

The main goal of modern pedagogies is to create open-minded citizens and young people able and willing to study more and more, to find and acquire information on their own, in accordance with their interests and needs and requirements of the labor market, rather than just reproduce pieces of discrete information transferred from the teacher. This aim can be fully achieved by creating a democratic education system based on freedom and responsibility of the individual. The student should be the one who decides what he learns, how he learns and when he does that, and the teacher should become a facilitator which must assure the freedom to learn (Rogers 1969).

The main problem of today's education system is to perform a bottom-up mindshift, bypassing a quite rigid curricula, such that the result would be a higher education that could be

described as follows (Wolfe, Steinberg and Hoffman 2014): Learning is personalized and competency-based; takes place anytime and anywhere; and students take ownership of it (Figure 1).

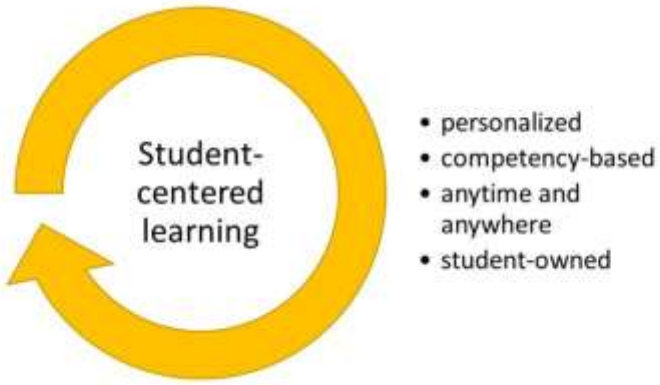

Figure 1 – Shifting to education model with another characteristics of learning

Republic of Moldova is a small "melting pot", so this peculiarity should be also taken into consideration when structuring an education system. More than that, this apparent issue can be turned into an advantage, as Europe is also multinational and multicultural, thus Moldavian students can be better prepared for mobility, being constrained to work in multinational teams even at home.

2. Learning Models

Prior to making the proper decisions on adjusting the educational system, we have to dig into the existing pedagogical models, such that we could draw conclusions leading to putting the best practices into action.

A didactic model comprising all the processes that are part of the education process is presented in Figure 2 (Illiris 2007):

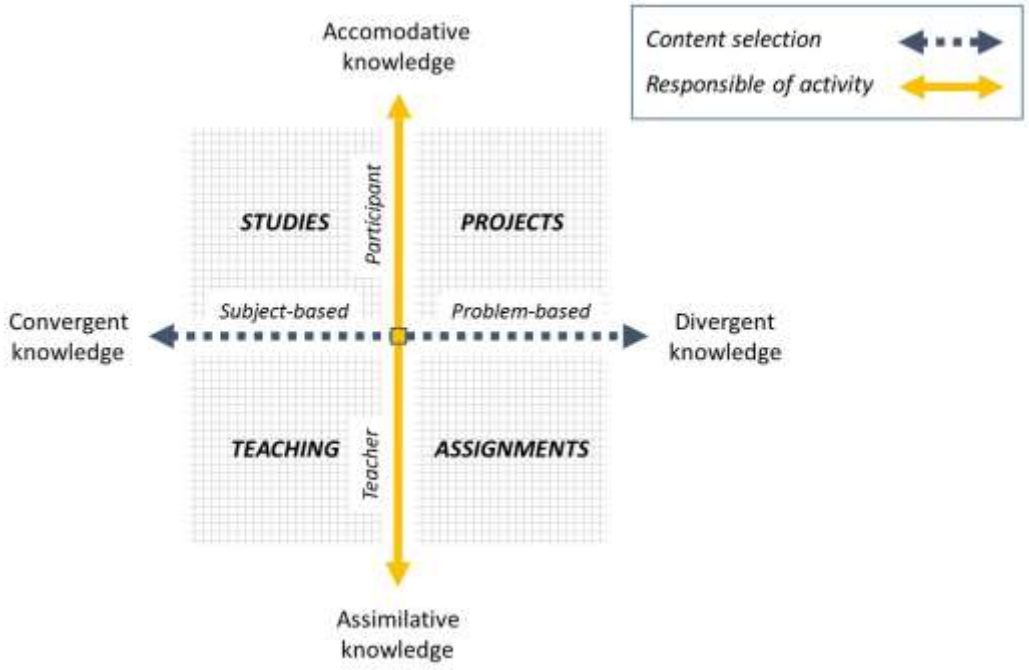

Figure 2 - A didactic model (Illiris 2007)

According to this model, currently our pedagogies are in the 3rd quadrant, adhering to the classical teacher-centered education, with subject matter orientation, rather than problem orientation and teacher direction rather than participant direction. The main issue of this kind of teaching is the lack of holistic approach, thus producing graduates able to reproduce discrete pieces of information on different subjects, yet unable to integrate all that knowledge and lacking the experience of problem solving and research skills. But, treating learning as a holistic process of „adaptation to the world" permits to build conceptual bridges between classroom and real-life situations and setup the learning as a continuous and lifelong process (Kolb 1984). So, we would like to design an active learning system that would move the "clock hands" to the first quadrant - projects, where the student is shifted from the peripherals to the center of the study process and the content of the studies from discrete, short-term assignments to semestrial, medium-scale projects. Moving in the positive direction, meaning counterclockwise, we can reach the first

quadrant via the fourth, bypassing the rigid curricula by simple means of tailoring the content of each subject for student's needs, as a first step towards the true PBL-model.

Another model is given by (Fox 1983). The author outlines four theories of teaching:

- *Transfer theory*, which treats knowledge as a commodity to be transferred from one vessel to another;
- *Shaping theory*, which treats teaching as a process of shaping, or molding students to a predetermined pattern;
- *Travelling theory* which treats a subject, as a terrain to be explored with hills to be climbed for better viewpoints with the teacher am the travelling companion or expert guide;
- *Growing theory*, which focuses more attention on the intellectual and emotional development of the learner.

On a closer look, these theories overlap the scheme proposed by Illeris (Figure 2): Shaping theory = Assignments (quadrant 4); Transfer theory = Teaching (quadrant 3); Travelling theory = Studies (quadrant 2); Growing theory = Projects (quadrant 1).

As an outcome of the paradigm shift, we will jump from the convergent thinking with the unique correct answers to the divergent thinking, allowing a multitude of solutions for the same problem, stimulating imagination, creativity and fostering the desire to research. Further on, we will propose ICT means to help move from teacher-centered learning to learner-centered model and further on, to learner-driven model, when the student him/herself shapes his/her course, having the necessary knowledge, experience and background to be able to do so.

3. Setting up a PBL Environment

Setting up a PBL environment is a multi-dimensional task, as it should cover both the learning process management part, and the contents of each course. In terms of management

process, there is the student-teacher/facilitator communication regarded, as well as the document storage and management part. At content level of each course, there is enough room for ICT to help tailor even the oldest and most rigid parts of the curricula to the needs of an individual.

3.1. Learning process management

There are different models of PBL implementation, but in the context of training software engineers, the experience reflected in (Zapater, et al. 2013) has to be mentioned. The authors have used the SCRUM methodology on an experimental group of students, methodology that is heavily used in software industry. Thus, besides the pedagogical objectives the students had to study also versioning control tools (to share the code with team members), to divide complex tasks into smaller ones, to analyze and measure the time needed for each of the tasks, to develop communication abilities for an efficient interaction with their colleagues. The quality and quantity analyses of the Agile-PBL experience vs. traditional methods have shown more student satisfaction and motivation. Yet, the same measures show that there are negative effects related to additional planning and coordinating time (planning overhead) and also related to additional *required* tools in use. The main conclusion is that information technologies should be an ally in obtaining learning freedom and by no means a new constraint.

The modern development environment does not allow any more to regard education in its classical form. This approach isn't enough competitive in the 21st century, and also technical and scientific revolution does not happen once in a century any more, not even once in several decades. Major change takes place once in a couple of years or even months.

Most of the fields of human activity have gone through several revolutions: industrial, technological, electronic, and digital. Almost everything is being digitized and information technology is applied all over the place, thus increasing the efficiency of most processes. Even in

arts, where the human being is still the only one to create, information technology is heavily used.

These trends especially impose using the ITC progress in the education as well, and those who stay with the old school take a huge risk not to be competitive any more on the international level as well as on regional level. Currently, we have a wide set of tools and technological possibilities to streamline the traditional education as well as to be used with PBL methodologies. Amongst the main requirements we could enumerate the following:

- *online storage*, collecting and storing information and knowledge;
- *eLearning*, information and knowledge presentation tools;
- *ePractice/ eSimulation*, communication, activities (including interactive), teamwork, providing practical learning (a rich set of experiences and practical simulations, real-life cases and problems, including technology use and augmented reality);
- *integration*, tools for processes' and learning system management with possibilities of integration and collaboration with other systems;
- *mobile*, possibilities to integrate and use all the platforms and mobile technologies.

Most of these requirements are already fulfilled by a set of solutions and tools, some with 15-years experience already.

As an example, the Moodle platform offers advanced options for e-course creation, remotely accessible, with a large set of activities – that cover widely the content (*eLearning*).

There are also tools and solutions provided as free of charge by companies, such as Google, Microsoft, one of these tools being also Office 365 for Education with a set of tools that are suitable for streamlining the education process and also PBL.

3.2. Content adjustment

ICT is a highly dynamic field, where changes are a routine, so the study programmes for any IT-related course should be revised at least once per academic year. Yet, changes need approval by the authorities. A new or revised course should be reviewed and approved at the university level and, furthermore, at Ministry level, which is not a short way to go and, it would take more time to do than reasonable for the IT sector, as by the time the changes are approved, there's a new emerging technology on the roll that must fit into the study curricula.

Things aren't bad anyway and, ICT offers a large range of possibilities to adjust even the existing curricula to the needs of each group and even more, to the needs of each individual. Actually, it's only a matter of mind shift of each teacher to use ICT to the advantage of the student.

We, the authors of this article, would like to share the experience of curricula adjustment by means of technology. Let's have as an example the subject "Object-oriented programming, analysis and design". The approved curricula on this subject comprises lectures, seminars, individual assignments (laboratory works) and an individual semestrial project. At a glance, it looks rigid and not PBL-oriented at all. What can be done?

First of all, at seminars, the teacher can divide the class into several groups and ask provocative questions that would stimulate each group and individual to find answers. Questions or problems should be formulated such that there could be more than just one possible correct answer. Seminars should resemble a set of debates, where each team searches for arguments to support their solution, than just answer the questions or reproduce some information.

Laboratory works that are actually a set of personal assignments can also be revised, without even changing the content. The key is to understand that the programming paradigm remains the same: object-oriented programming. There's no need to require everyone to solve the tasks using only one programming language, preferred by the teacher, let's say C++. The

facilitator (or teacher) should be aware of the most of the existing object-oriented programming languages and must be able to, at least, read and understand each of those source codes. This approach is necessary for letting the student decide which programming language he/she prefers to study to accomplish the task. Certainly, students are more likely to follow the latest trends and study what's needed on the labor market (so lots of them can pick languages like Java, C#, Python or Ruby, instead of C++). More than that, laboratory assignments can be also given to groups of students, rather than individuals.

The last, but probably the most important part of the curricula on the subject taken as example is the semestrial project. The facilitator should split the class into groups and let each group research and come with a project topic proposal, which is later on discussed with the teacher and approved. Certainly, the facilitator should provide some general guidelines for the best topics to be chosen, but the students are the ones that should find the problems interesting and challenging for them. Designing and coding the applications/systems should be done also using those tools, frameworks and programming languages that are chosen by the students.

4. Conclusion

A society can be free and democratic only if each individual is free and responsible for the choices he makes. These important qualities are attained by one only if "practiced", one being put to the center of the learning context. Education from this point of view can be regarded as a framework for creating the best conditions for personal development (Illiris 2007).

In The Republic of Moldova, besides the limited autonomy of the universities, the education is also constrained by different social and cultural aspects. Therefore, the PBL methodology is the necessary organizational method of education that would allow its liberalization.

There are different techniques that come in handy to adapt PBL for the engineering education, such as Agile-PBL, but the study (Zapater, et al. 2013) argues that the methodology by itself are not enough to increase student motivation. If the context determined by our curricular constraints is to be added, then the fundamental conclusion is that freedom can be offered to the student at content-level, determined by PBL on one side, and on the other side – by the tools offered by ICT.

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