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The first steps of project-based education in Lithuanian high schools

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Abstract

Globalization of nowadays education and science promoted by various international programmes provides with unique opportunities to renew some old educational approaches connected with linear application of education within higher educational institutions in Lithuania. Nowadays Nature science development confirms fact, that there are more approaches to reality, than finding the only one epistemological truth. In parallel there are several aspects, dimension of the same truth in the complex systems of the reality. Educational process regarding its complexity largely belongs to the complex, non-liner, opened and non-reversal systems. That's why we must be focused on the dynamics of educational components rather than on its components alone, that are at the second rate of importance. Those relations have influence on the whole system change largely. That is the reason why authors employ the theory of Synergy, that's focused on such kinds of relations. Authors explore the roots of Synergy theory its approaches of application in Educational systems. Project-based learning is kept as one of active forms in the complex education systems. There are emphasized problem solving competences in project-based learning, the synergy of separate cognitive steps in learning process that are reflected in two higher educational institutions within bachelor degree students in Vilniaus kolegija / University of Applied Sciences and master degree students in Vilnius Gediminas Technical University. Peculiarities of Project-based learning are revealed through review of problem solving application methodology to promote students 'cognitive and meta-cognitive skills, connected to decision making, social, group working skills. Authors emphasize on College level students 'shortages of competences related to finding the right information, structuring of problems components, modelling of project solving strategy. This reveals students paternalistic manner of thinking that impede learning process due to the lack of habits of thinking systemically. That shows shortage of applying innovative educational methods in the College. Respectively, educational experiment revealed, that Master degree students in the University demonstrated much higher achievements in operation of cognitive and meta-cognitive competences in completing problems solving tasks, what demonstrated their success in whole project implementation more, comparing to the Colleges' ones. Authors of this work emphasize the importance of treating all students across the different subjects with problem based learning methodologies in order to improve project implementation skills in Higher educational institutions.

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1. Introduction

This world is organized intricately. It is the world, which is incessantly emergent and in which, there are variety of twists related with further choice of ways to develop. Diversity is the base of permanent and dynamic system development process. Development tendency of science, nowadays, approves the fact, that the truth may not be one, in parallel, alternative truths can also exist, as well as several attitudes to the same thing (Vollmer, 1984). Education process belongs to difficult, non-linear, opened, unrepeatable (irreversible) systems. Therefore, analyzing education systems, it is more important relations between them, which determine changes of systems, than objects which form systems (Vollmer, 1984). In this article, opportunities are analyzed, which allow us to look from another point of view to education system and ongoing alterations in it, using Theory of Synergy.

The aim of this paper – justify theoretical and practical assumptions of the project-based method in teaching and learning processes, theoretically.

Tasks:

1. To show theoretical sources of teaching and learning project, through the Theory of Synergy.
2. To describe project-based teaching practical implementation results in some higher schools in The Republic of Lithuania.

Methods that have been used: scientific literature analysis, structured students interview and questioning, statistic evaluation of data.

Synergy-is the study about self-coping (self-organization), processes of communication, ongoing in complicated, opened systems of varied nature, which are at non-balanced state. It is a mutual operation or operation in one direction, when the result is higher than influences of the operative parts algebraic sum (Haken, 1990). Synergy is approaching as a new scientific paradigm, also as a new uncommon thinking and as a new structured complex view of the world. However, 'novelty' of synergy is quite conditional, because its beginning of using is considered in 1969. The term *synergy* (gr. *Sin*-mutual, collective, *energia*-process, mutually active power) was introduced by Hermann Haken, who is professor of Stuttgart University. H. Haken synergy- is language, which is convenient and easy to talk about difficult systems, about specific emergence of structures. Following all of the process not 'from the bottom to the top'- from the particles to the whole, but 'from the top to the bottom'- going from the system to the particles (Danilov, 2002).

Invoking synergy, we can state that mans position is changing in cognitive and practical work of the system. During this process, unique abilities of the man is shown- from the set of possible options to select one, which will be the most suitable, seeking further existence of the system, its transition to the higher level. To help the learner understand the science as a multiple, though mutual structure it is not enough to connect formally or to integrate related educational things. Attitude to disciplines should and could be based on the principle of interaction, whereby Theory of Synergy is based on.

Synergy in education system evolution is relevant because it gives conception of opened and non-linear systems development as a special thinking style. In this case it is important not because of its doctrinal, but because of its methodological significance.

In order to progress towards the highest level of education- in this process qualitative interacting elements (students, lecturers, society) education (development) transformation, which would be the main criterion of the purpose that is sought, it is very important openness of the system. Openness to everything: spiritual connection, honest communication, sharing of experience, open-mindedness to innovations and for life itself.

2. The method of the projects

The method of the projects – it is an excellent way to seek the purpose. The method of the projects, allows connect and didactically motivate link of the theory and practice. In order to implement, theory is not enough. Theory and practice are related in forms and don't exist without element which connects them. The method of the projects is that exact opportunity, which solves not only the problem of concepts unity, but also helps to justify evolution process of the systems and qualitative variation, nascent and determinant opened and spontaneous processes, because of their interaction.

In modern-day school of Lithuania a lot of various ranges of projects are enacting. The purposes of those projects: 1) to help to learn and invoke various methods of learning and analyzing; 2) to work creatively; 3) to plan work time; 4)to evaluate information, innovations of science critically and relate them with life; 5) to convey peculiarity of project-based work accomplishment and description presentation to students; 6) to develop rhetorical abilities of students; 7) to develop the feeling of responsibility; 8) to encourage students' motivation; 9) to help orient in alternative of profession. In order to find out the extent, popularity and ranking among the other educational methods of the project-based work, 216 teachers and 1068 students were interviewed, when the research was performed (the research included the spectrum of geographical projects, which was performed in various schools of Lithuania, in different school age groups) (Birgelytė, 2005). Results of declarative research, allowed to point- out the most significant feature of the project-based work.

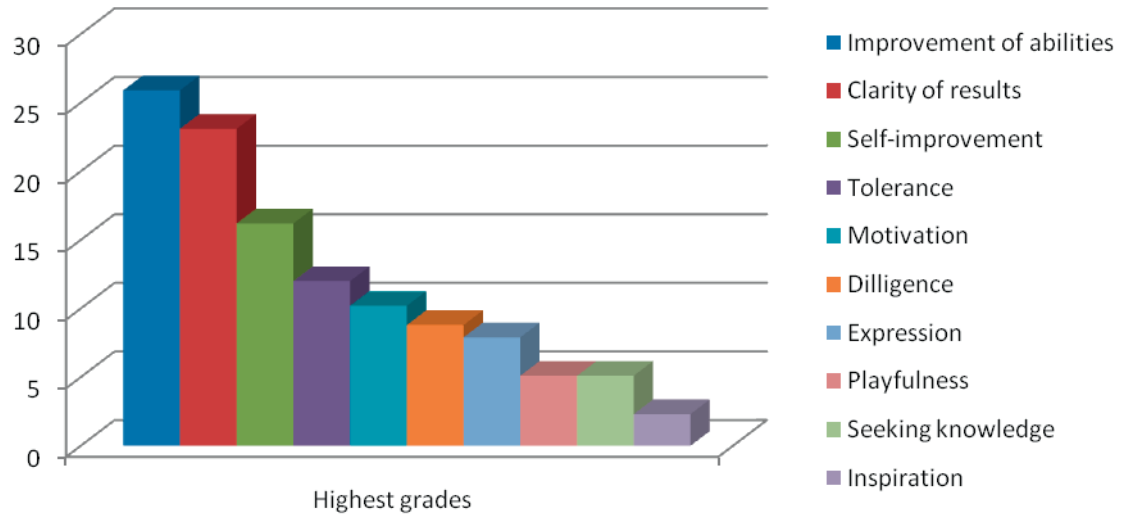


Fig.1. Most important aspects in project activities

Synergy can 'advise' which step to take next in the process of the research and what to expect (Prigozhin, 1986). The problem, which was brought-up correctly and its alternative of solution manner direction, is most frequent no less valuable than the solution of problem itself. In the picture above, there are the features which were pointed-out and also related with the purpose of the system - qualitative change in it -acquiring of education. Purpose or result is seen as mutual knowledge, and most important, abilities unity link.

Among the multitude of projects we meet a variety of forms. Some of them could (and should) be applied in higher schools. 'Free' projects, which there are majority- they are fundamentally different from

traditional forms of learning, because they have their own axis- pending problem, which apparently solves their 'projectivity'. In projective work (we dare to state- also in whole educational process) there is not unanimously initiated and cut-and-dried labour course- it is rather purposeful collaboration, creative act, which was already mentioned. Baseline of project-based work is the problem. The solution of the existing problem is definable even in the projects' definitions. The key point here lies with the specific problems, not only with theoretical knowledge, that could help to solve the issue. In the picture below, there are several stages of problematic learning.

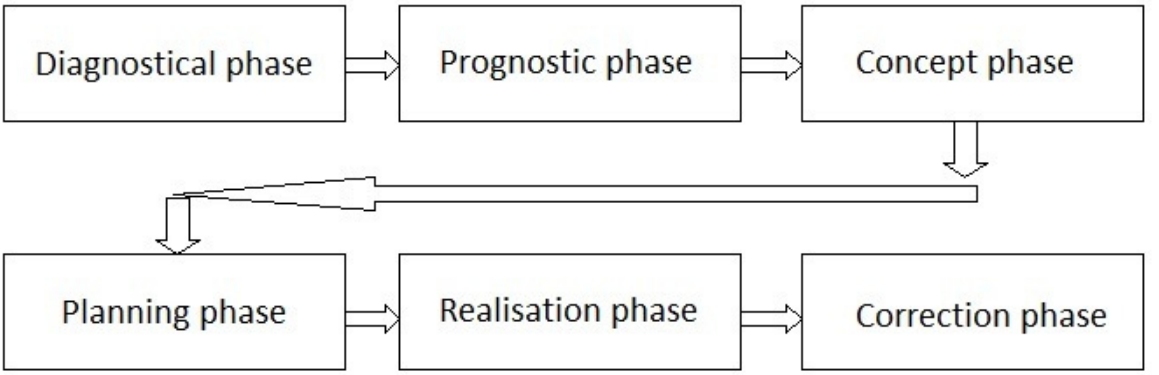


Fig. 2. Phases of problematic learning

The depth of ideas, amplitude of topic, topicality, time, during which the work is done and many other, very frequent unpredictable processes, determines a lot. Project as a system openness, dynamism and non- conservatism asserts in here. Traditional forms of learning are relatively stable. Extreme stability of the system, prevents its development, also makes it conservative and even lastingly stable. Qualitative changes don't happen and cannot be happening in extreme stable and durable system, development of the system freezes (Haken, 1990). Project-based work gives an opportunity to think and create differently.

Planning and working project-based work, a plethora of questions, issues and quarrels appear. The link, which connects them is creative thought. This is necessery enviroment for further evolution- for non-balanced behavior coming, during which non-linear processes begin to imply.

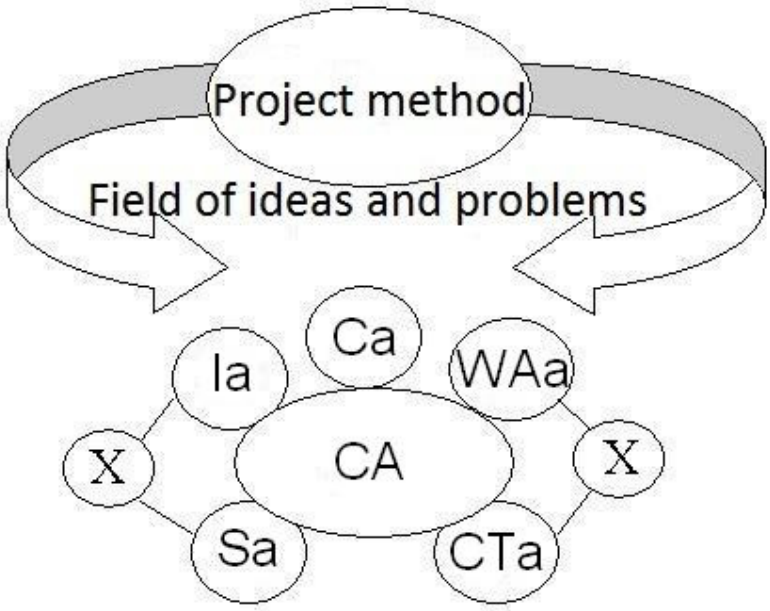


Fig. 3. Synergetic visualisation of didatic project

Therefore, in the scheme above, depicted dissipative themes and ideas field is necessary. Reflections, contentions and uncerainties are intense activity expresion of new thinking, which is participating in the system. All this heterogeneous activity, leads to the *self-determination* of which will depend on which way the system will evolve. Idiosyncratic features of the project-based method- the main drive of the system,which rears **abilities** (unconsciously bounding movement, which moves towards the varied purposes qualitatively), which in each system realizes at any but a certain set of its‘- individual (*Ia*), social (*Sa)*, communicative (*Ca*), critical thinking (*CTa*), work and activity (*WAa*) and didactic model abilities (marked in the scheme x), which represents particular, practical, objective (e.g. chemistry science)abilities. During resolving, the opportunity is given to choose your own way (purpose). The Choice leads the further development of the system and it comes out of chaos. A new phase of system life begins, in which are very important interaction and openness. All the types of skills, which were listed before, are inextricably linked, supplementing, extending one another, accrete into a harmonious whole, which is expressed by common purposes- ***CA*** (common abilities). In the system, signs of procedure begins to emerge again.

Synchronization- the term which was also implicated by Theory of Synergy, talks about the fact that in all systems exists strong self-organizing energy. Considering each of the project as a separate, independent educational system, which is applicable to many things, also inclusing one particular thing widely, it can be assumed, that the project-based work itself is based on sinchronization process, when the systems operate individually, they take mutual energy, which gives the base for popularity of projects‘ method and massive outspread, which influsences entire educational process. This energy transfering from one system to another would be the aspect of interdisciplinary integration, adopting the best features of each system and taking skills not only during the qualitative variation of the particular system, but also during the entire synchronized existence of the systems and combination in educational process. In the didactic projects system, we will notice internal sinchronization among its participants. In pursuance of the project, the process is observing, when the work of the more active team, group or couple (synergistically- *higher*

rates...) ‘infects‘, ‘dislodges‘ and inspires all around it, even those, who have never been characterized with the great desire to affect (lower rates). The process of synchronization ‘steels‘ and reinforces the system itself, because it is a great pretext for emergence of competition between separate systems and participants in them.

The project-based study method reveals procedural attitude to learning probably the best. Its essence- to help students to look at learning as a self-regulating process, in which each student must form in himself skill of planning, organizing and implementing activities. The stress of modern and popular project-based activitys pattern, is emphasized because of its efficiency, in pursuence of economic, social, managerial, educational purposes of the activity (Baron,1998; Bransford & Stein, 1984; Bransford & Stein, 1993). Didactic flexibility and openness of the project-based learning is emphasized, because the project-based teaching and learning involve such an important teaching and learning aspects as problem-solving, strategic, critical and creative thinking and also working in groups.

One of the central axes of the project-based learning is problem-solving, because the essence of each project- to achieve certain targets within a certain period of time, taking advantage of of certain material, financial and human recourses. According to Vollmer (1984), problem arises where there is shortage, lack and deficiency in a particular situation. LAuer and Spada (1998) define problem as a certain gap between current and coveted situation. That is why, usually the result of project-based work is the solution of the certain problem, i.e. approaching current situantion to coveted.

The majority of problem-solving specialists (Bransford & Stein, 1984; Prigozhin and Stengers, 1986; Vollmer, 1984) agree, that problem-solving cycle consists of four main components:

1) Identification of the problem;
2) Definition and representation of the problem;
3) Problem-solving strategies‘ exlution;
4) Problem-solving monitoring and evaluation.

Exlution of components of problem-solving with cognitive and meta-cognitive aspects are considered as as essential element of the problem of thinking, upon which depends the success of problematic learning. One of the most important cognitive processes of problematic learning are: categorization- the ability of defining, analogization- the ability of comparing (Gentner, 1983, 1989), reasoning of causality (Jonassen *et al*. 2006), argumentation (Duschl & Osborne, 2002), analysis (Birgelyte, 2005), designing (Kanishauskas, 2003), synthesis (Tidikis, 2003).

Meta-cognitive level of solution to the problem, respectively define such component as ability to analize your process of learning and working, to reflect and evaluate the course of team work, to raise correct questions, which help to find missing information (Birgelyte, 2005). Probmel-solving cognitive and meta-cognitive elements successfully complements one another and compose solid construction of problematic thinking, because the ability to analyze problems and to make decisions are elastically related with abilities to analyse your problem-solving processes (Flavell, 1987).

Problem-solving methods are especially important in higher school, where is the intention to form students’ critical thinking (Birgelyte, 2005), the most optimal solution to the problems (Bransford&Stein, 1993; Hayes, 1989; Kairaitis, 2003) and creativity (Vollmer, 1984). Therefore, problematic learning method was tried in parallel, during the education project in Vilnius College and Vilnius Gediminas Technical University.

3. Findings and results

At Vilnius College Faculty of Agrotechnologies, during the education project testing with second year students of Agribusiness management of continious studies, essential conditions were defined- the lack of expertises and possibilities of method expansion in the college level.

The project involved 16 students in the direction of the Management, who worked in groups of three. Each working group has been distributed in roles: team leader, information searcher and information deliverer. For each problem (case analysis) the spectrum of questions was proposed, which was up for meta-cognitive and cognitive abilities development. To develop cognitive powers, the following questions are appointed:

- What is the main problem of the story which was given?
- Which structural component of the problem would you point-out in the problem?
- What similar problems do you know, where similar structural components dominate?
- What is the aim of solution of the problem?
- What are the criteria of solution success?
- Which situational components of the problem would you point-out in the problem?
- What similar problems do you know, where similar situational components dominate?
- What information is know, which is needed to solve the problem?
- What information is missing, on purpose to solve the problem?
- What information can be found to solve the problem?
- What are the possible solutions' strategies, and why they are available?
- What would happen, choosing one or another variant of the problem solutions?
- What strategy of the problem solutions would you choose and why?
- Is the variant of the problem solution adequate? Why?
- Does the variant of the problem solution, which was chosen, meet the stated goal and criterion of success? Why?
- Is this a viable solution to solve similar problems in the future? Why?

Meta-cognitive spectrum of questions has been formed, according to the roles of team members. In their aim was to clarify the group members' ability to work systematically and coherently, according to the role which was taken. Accordingly, the questions for cognitive abilities development, was directly diverted to the problems exclusion, analysis and solution.

To develop meta-cognitive powers, specialized questions for the leader, information searcher and deliverer, were formulated.

Questions for the group leader-moderator

1. How did you organize a group work?
2. What was the aim of the work? Did you reach the aim? Justify answers.
3. What knowledge, skills and personal qualities were needed to solve this problem?
4. What aspects of the solution to the problem are successful? Why?
5. What aspects of the problem can be solved better? Why?
6. How did you ensure the communication between the group members?

7. Are the team members empathetic to each other? Justify.
8. What do you do, to avoid any conflicts during the work time, between the working groups?
9. What decisions do you make or would make in case of a conflict?

Questions for information searcher

1. What information retrieval sources did you use and how they were selected? (Classify).
2. Why do you think, that the sources of information which was chosen are reliable? Justify.
3. Did you find all information that you were looking for? Justify.
4. What would you do differently next time?

Questions for information deliverer

1. How did you prepare for information delivery?
2. Did everyone in your group understand and approve the information? Justify.
3. What implements do you use for information delivery?
4. How do you assess presentational material preparation of the group? Why?
5. What would you differently next time?

The spectrum of cognitive and meta-cognitive questions was classified into cognitive (ability to identify the problem, to point-out the component, to define the strategies of solution and to assess solutions) and meta-cognitive abilities (ability to analyze and assess the problem-solving process, according to the role you have taken) of problem-solving. The main evaluation criteria of the questions' answers were: 1) Diversification of the answers (exclusion of various aspects of answers*) 2) Argumentation (the justification of opinion position)*. During the educational project at College, the obtained data were compared with the Vilnius Gediminas Technical University conducted analogous research of problematic learning (Table 1).

Table 1. Holistic analysis of cognitive and meta-cognitive abilities of Vilnius College and VGTU students

Cognitive and meta-cognitive abilities		Mark	
		College students	University students
Mata-cognitive	A - for group deliverer: ability to analyse and to appreciate the quality of presentation matter	6	8
	B - for group searcher: ability to analyse and to appreciate information searching process	5	7
	C - for group leader: ability to analyse the process of group work	7	8
Cognitive	D - ability to valuate solutions	6	8
	E – ability to create problem-solving strategies	3	5
	F – ability to identify it's components	4	7
	G – ability to identify the problem	8	9

In comparison with the students of University, the first variants of problem-solving obtained by the students of College, revealed systemic weakness in problem-solving. College students were less successful in defining problems and their components, and excluding problem-solving strategies. Accordingly, in meta-cognitive level, College students were less successful in identifying their own particularity of work planning organization, the most common answers in general terms, superficially describing their work structure, course and choice criterion.

In comparison with the students of College, the students of University were able to identify problems better (10%), to define their structural components (30%) and also to suggest the strategies of problem-solving (20% advantage). This shows that higher cognitive processes such as analysis, synthesis and assessment are developed better by the students of University than the students of College.

During nurturing tasks, difficulties in cognitive and meta-cognitive skills shows, that in college sector of higher education is still too little attention is paid to application expansion of contemporary and active methods; group learning methods are encouraged not enough. The main learning strategy of students is to repeat knowledge that they have heard in a lecture. Teaching method like this, discourages students' analytical and creative thinking, also makes them puppets of passive and formal learning.

At the end of the first phase of education project, after repeated questioning of students, while solving the problem, was noticed that through meta-cognitive skills training questions, College students' meta-cognitive (self-assessment, analyzing the problem-solving process) and cognitive (naming the problem and its components exclusion, comparing with other problems and possible solution to the problem) powers was improved. However, even at the end of education project, was still found difficult to realize such capabilities as naming the missing information, supply and description of some problem-solving strategies. This shows College students' information retrieval skills gap and limitation, which confine the information that was given in the text or video material, trying to work out the rest of information. The analysis results of education project reveals, that students are still not paid by self-study, in many cases, they delegate teaching initiative to teacher (lecturer), in accordance with their own more passive learning model. Therefore, one of the biggest challenge facing higher education in Lithuania is to implement coherently systematic changes, which are related with the realization of the principles of modern didactics (Birgelyte, 2005), in order to encourage students' cognitive and meta-cognitive expertise expansion, while studying and solving problems.

4. Conclusions

1. Synergy is treated as a new scientific paradigm, which is important with its methodological significance in evolution of education system. This methodological assumption allows to look into project-based education method newly and reveals new opportunities to control and optimize the process of education, targeted to the results.
2. The base of project-based work- purpose, which incorporates participants of the project at operating knowledge and abilities purposefully.
3. In the systems, existing strong self-assembled energy transfer to other systems, in the educational process is an interdisciplinary integration term.
4. One of the most relevant project-based learning outcomes - cognitive and meta-cognitive skills formation, which is closely related with problem-solving, that is why problem-solving should become a fundamental principle of any course of learning.
5. Education project showed, that college-level students are doing harder at analyzing and offering the ways of solving problems in variety of problem-solving, comparing with University students, that is why, in order to encourage project-based work method, it is neccessery to improve students′ college-level competencies of Lithuania.

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