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Problem based learning - involving business stakeholders in educational process

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Theme-based training / Date
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Description:
In technology-driven study programs and courses, problem-based learning combined with the involvement of business stakeholders in the educational process is considered the ideal solution for dealing with changes in the labour market.

GEOBIZ project approach, activities and results are presented.

Content

PBL in a nutshell

- Traditional Learning vs. PBL
- Steps involved in PBL
- Teacher's and Students Role In PBL

GEOBIZ approach

- PBL as a bridge between university and business
- Example of the course realized with PBL approach
- Evaluation of the PBL model

Conclusion

Geoinformatics

- present in numerous disciplines and therefore the education of geoinformatics experts is extremely important today

Challenges

- the lagging behind of the academic sector in introducing new technologies into the teaching process, which results in new experts not having the knowledge and skills needed by the business sector.

Global character

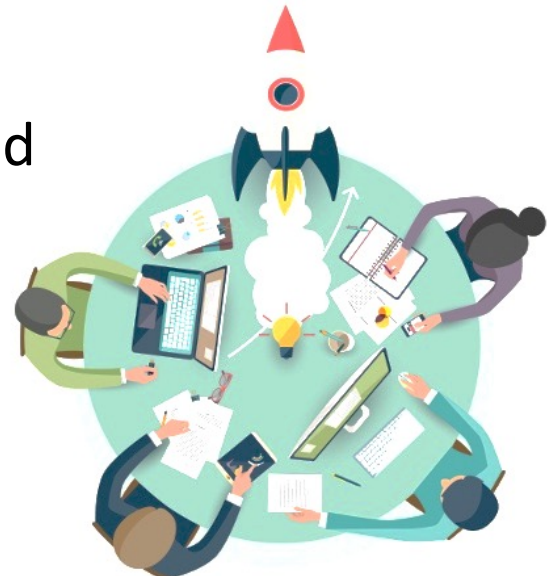
- numerous projects are underway in search of solutions that will enable the modernization of the geoinformatics curriculum that will follow rapid changes in technology and user needs.

Problem-based learning (PBL)

PBL is a student-centered **approach** in which students learn about a subject by working in groups to solve an open-ended problem.

The PBL process **does not focus on problem solving with a defined solution**, but it allows for the development of other desirable skills and attributes.

This includes knowledge acquisition, enhanced group collaboration and communication.



Problem-Based Learning (PBL) vs. Case Based-Learning (CBL)

PBL – Students learn about a subject through the experience of solving an open-ended problem

CBL – Similar to PBL but attention to the business context

- Real world - expose students to viewpoints from multiple sources and see why people may want different outcomes.
- Start with a story (specifying the business context)

It does not really matter if we call it PBL or CBL!

Traditional Learning

Told what we need to know

Memorize it

Problem assigned how to use it

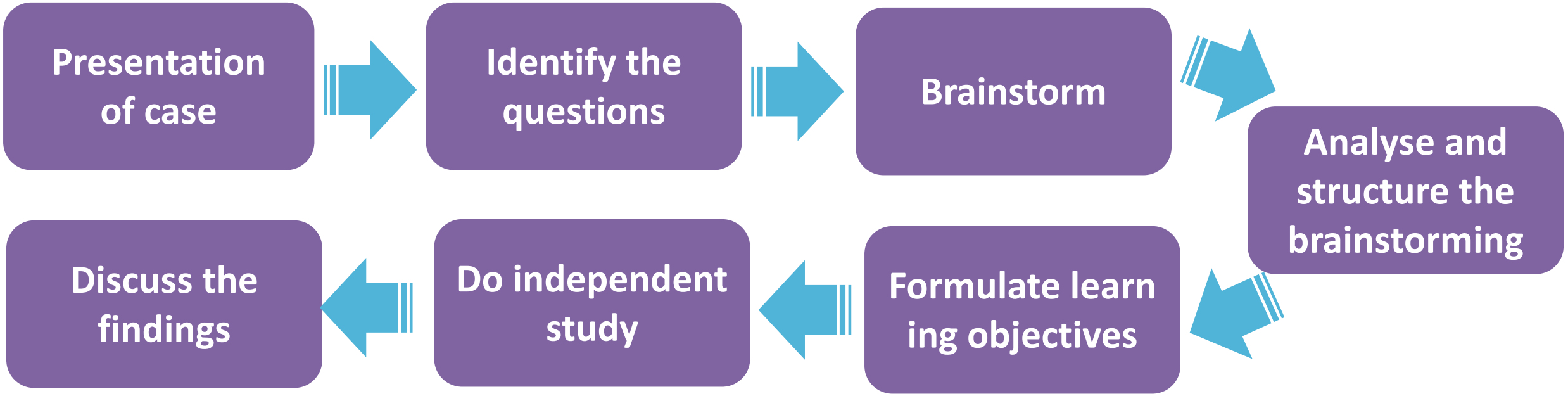
Problem-Based Learning

Problem Assigned

Identify what we need to know

Learn & apply to solve the problem

Steps involved in problem-based learning



Source

Problem-Based Learning at Maastricht University

Video: PBL in a nutshell.

Teacher's Role In PBL

- Be able to provide support, empathy and inspiration
- Facilitate thinking, growth and engagement
- Generate classroom activities based off of understanding students
- Feel safe to experiment and free from strict time constraints

The Role Of The Students (1)

Students collaborate on all aspects of the problem to find the best possible solution.

1. **Analyse the problem** and the questions it brings. Break down the problem into components that can be used to solve it.
2. Make a list of **what is known about the problem**. What do colleagues from the student team know about the problem? Do they have experience related to the problem? Discuss the contributions expected from team members. What are their advantages and disadvantages?

Source

The Role Of The Students (2)

3. **Describe the problem in own words** and take into account the knowledge and experience of the team as well as what else needs to be known to solve the problem.
4. Generate a **list of possible solutions and rank the solutions** and choose the solution that the group will perceive as the best
5. **Establish a timeline** with concrete actions.
6. Generate a **list of topics that still needs to know** about the problem in order to solve it. (Consider what information the teacher can provide.)

The Role Of The Students (3)

7. Organize and **write a report** and **using supporting documents**
8. One of the goals of PBL is to **present the conclusions** as well as the **basic knowledge** that the team worked on.
9. **Reflective thinking and knowledge transfer** are important components of PBL. It helps students to be more aware of their own learning and teaches them how to ask appropriate questions to solve the problems that need to be solved.

GEOBIZ Project

The aim of the project is to answer the question of **how to improve the geoinformatics ecosystem through the development of a new and innovative model of cooperation between the business and academic sectors** which will:

- support the academic sector in the modernization of study programs
- modernize technologically advanced parts of geoinformatics studies
- develop a collaborative model that will benefit all subjects of the geoinformatics ecosystem.

GEOBIZ project objectives

The primary focus is to strengthen the capacity of academic institutions to better address the needs of the developing geoinformatics industry with a focus on:

- **Establishment of new and innovative forms of business-academic cooperation** that will support interaction in the teaching process
- **Establishment of tools (platforms) for communication and cooperation** to support excellence in geoinformatics.
- **Development of innovative teacher training programs**, practical methodologies and content for technologically advanced subjects in geoinformatics.
- **Implementation of modern techniques and technologies in geoinformatics teaching**.

GEOBIZ consortium

Program partners

1. **University of Zagreb, Croatia**
   Faculty of Geodesy
2. Catholic University of Leuven, Belgium
3. University of Split, Croatia
4. Bochum University of Applied Sciences, Germany
5. University of Beograd, Serbia
6. University of Novi Sad, Serbia
7. GiLab Ltd., Serbia

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8. Polytechnical University of Tirana, Albania
9. University of Tirana, Albania
10. Land & Co. Ltd, Tirana, Albania
11. University of Banja Luka, Bosnia and Herzegovina
12. University of Sarajevo, Bosnia and Herzegovina
13. Gauss Ltd, Bosnia and Herzegovina
14. University of Pristina, Kosovo
15. University for Business and Technology, Kosovo
16. Technical University of Moldavia, Moldavia
17. State University of Tiraspol, Moldavia
18. University of Montenegro, Montenegro

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GEOBIZ - Project curriculum development

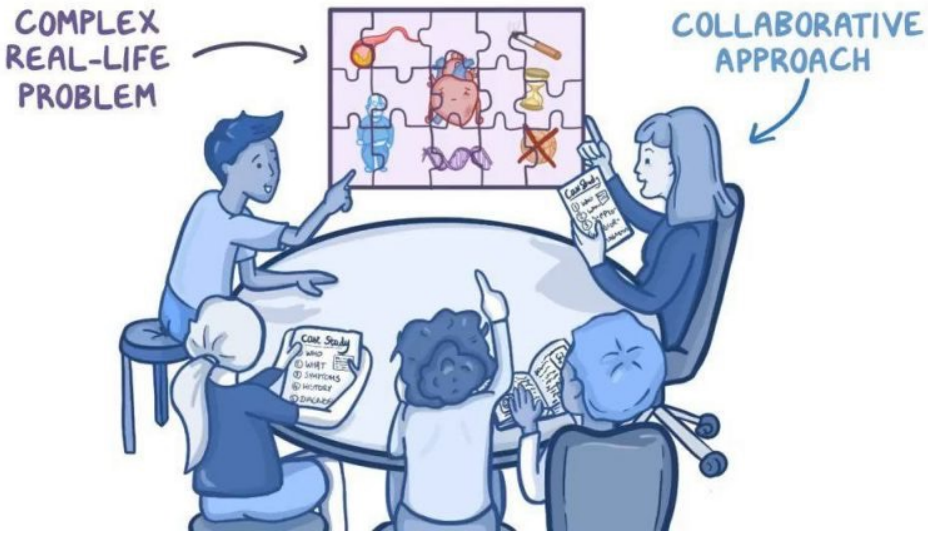
- As in any CBHE project, goal is to developed new or modernize new courses
- In GEOBIZ we start with **identification of cases whit which businesses deal in practice**
- Those cases have been **transformed in tasks / exercises** which **should be implemented** in **practical part of technology driven courses**…

GEOBIZ business driven cases were prepared:

1. Soil moisture for micro-locations
2. Statistical Surveys I
3. Utility and Government Services
4. Register of Spatial Units and Addresses
5. Geovisualization in Spatial Epidemiology
6. Modelling of house prices using machine learning
7. GPS for Topographic maps
8. Development of an application for applying GNSS in agriculture
9. Noise mapping using mobile devices
10. Mapping air quality
11. Digitization of paper urban planning maps
12. Geological Assessment of Soil Stability
13. Geodata for Urbanism and Spatial Planning
14. Geomarketing Analysis for Banking Services
15. Mapping and monitoring of aquatic environments using geospatial intelligence
16. Land cover and land use mapping
17. Crop monitoring with Remote Sensing
18. Application of remote sensing data in mapping and monitoring forest
19. 3D measurement with a terrestrial laser scanner and object visualization
20. Geodata for Civil Engineering and Architecture Designing
21. UAV in urban planning and management
22. Vectorization of 3D models of objects based on point clouds
23. 3D Urban information models for assessment of the solar potential of buildings
24. Statistical Surveys II.

Problem-based learning methodology added

- Tasks/exercises **transferred in to problem-based learning mode**
- **Involvement of businesses stakeholders** in educational process
- Introducing idea of **self-upgrading** projects



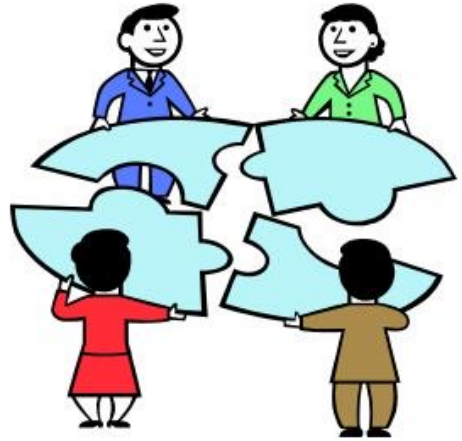
PBL as a bridge between university and business

Educators and employers share a common goal of "*educating / employing people who are highly motivated and who give 100% effort of their work*" (Walsh, 2007)

A lot what is taught is not applied so the students cannot see the benefit of this learning

Workers are not able to apply what they have spent their time learning

How To Begin PBL



1. Establish the learning outcomes
2. Find a **real-world problem** that is relevant to the students
3. Discuss **group work rules** to maximize learning success.
4. Practice **teamwork**: listening, involving other team members and evaluating their work.
5. Explore **different roles for students** to complete the task and see the problem from different perspectives
6. Determine how the project will be evaluated and assessed.

📌 Example of the course realized with PBL approach

Adjustment calculus course with PBL approach

- The course syllabus structure
- The course objectives/outcomes
- Problem/Scenario
- Learning method
- PBL tutorial process
- Assessment

Study program: Master program - Geodesy
Year/Semester: First/First
Course: Adjustment calculus – advanced
Lecturer: BB
ECTS: 4

Course Syllabus – Adjustment calculus

Course title:	**Adjustment calculus - advanced**
Study program:	Geodesy
Study level:	MSc, Academic
Module:	All
Lecturer:	BB
Course status:	Obligatory
ECTS:	4
Conditional course:	No

Number of hours of active teaching (per week)

Lecturers: 1	Excercise:	Additional forms of teaching:	Seminar research work: 3

Course objective

To master the procedures for solving the problem of estimating unknown parameters in the models of geodetic measurements through designing geodetic control networks for the purposes of staking out, building infrastructure, geometry control and exploitation monitoring of infrastructure facilities.

Learning outcomes

After the realization of the learning process, students should be able to independently and through the team work under the supervision of tutor, solve the problems of designing geodetic networks using all available literature and information technology and adjust realized geodetic measurements. Students should independently and through team work be able to critically analyze and select an optimal geodetic datum, design the geodetic network, create the plan of geodetic measurements and test the hypotheses according to the given criteria of accuracy and reliability in accordance with real professional needs.

Course content/Problem

Geodetic control networks, datum definition, quality and reliability measures, statistical hypotheses, error modeling and stochastic models are the content of the introductory lessons. Selected problem (scenario, case) should specify the task which should have an impact on the students to define the content of work in accordance to real-life engineering request (geodetic network) as a part of scenario. Based on real-life problem request, free control geodetic network should be designed for the needs of construction or monitoring the stability of the engineering facility. Measures of accuracy and reliability of estimates in the geodetic network should be harmonized with the allowed tolerances of the object's behavior. Through the problem solving the students learn how to solve geodetic datum problem and its impact on estimates, hipothesys testing, outlyers detection and the concept of reliability.

Literature

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Teaching methods

Course is realized through classroom lectures prepared in the form of PowerPoint presentations and group students work. In the initial classes, students are faced with the theory of the free control network adjustment and its impact on parameters estimatation. Students do their practical work within a team, according to the PBL model. Students solve a real geodetic problem, within a given period of time which includes the design and analysis of the proposed geodetic network. After the end of the work, a workshop is organized where students, in the presence of teachers and others by invitation, discuss, present their project solutions and evaluate their work, the work of other team members and the entire learning process.

Student workload structure and grade structure

	Lectures	Pre-exam obligations			Final exam		Total
		Elaborate (practicum)	Project work	Colloquium	written (calculation part)	oral (theoretical part)/presentation	
hours	30		80			10	120
points	10		70			20	100

Basic course information

Course objective

Course outcomes

Course content

Learning resources

Learning methods

Assessment

Central course idea:

Free geodetic network as a frame for designing, staking out, controlling and monitoring the stability of buildings,… ended with the assignment

- Indicator of the quality of teaching and learning and lets the students know what the course is about … (Woolcock, 2003; Altman&Cashin,2003)
- Both a professional document and a personal document (Parkes&Harris,2002)

Any subject area can be adapted to PBL with a little creativity.

Prerequisite. The prerequisite for attending the course is passing **Adjustment calculus** - Basic Course.

Problem/Scenario:

In a part of the territory measuring 2 km x 3 km, it is necessary to design a free geodetic network for the needs of construction and monitoring the stability of the engineering facility. Measures of accuracy and reliability of estimates in the geodetic network should be harmonized with the allowed tolerances of the object's behaviour. In accordance to the observation plan the measurements should be simulated, network adjusted and all required results reported.

How is PBL learning methodology harmonized with course content?

- Course starts with **mini-lectures** prepared in the form of PowerPoint presentations and continued with **group students work** (PBL)
- In mini-lectures - students are faced with the **theory** of the free control network adjustment, parameters estimation in GMM and hypothesis testing, **resources** they have on their disposal and shortly about **PBL**
- In group work – students with the teacher guiding, start with a given real geodetic problem, analyze it, define what they know and need to learn, collaboratively research within a given period of time, give the reasoned problem solution and report the results to the audience
- At the end of learning process **content knowledge**, **conceptual knowledge**, **problem solving abilities** and teamwork were assessed using he the **rubrics form**

How the PBL learning cycle looks like?

	Activity	Time frame
1	Introductory lectures / Geodetic control networks, datum definition, quality and reliability measures, statistical hypotheses, error modelling and stochastic models	Date: Time: 8-10 h
2	Forming a group, introduction to PBL, explaining the meaning of certain expressions and terms within a given scenario (asking questions, clarifying concepts, all team members must understand the requirements)	Date: Time: 2 h
3	Defining the problem (highlight relevant requirements crucial for solving the problem). Analysis of previously acquired knowledge in the context of the problem (presenting ideas, connecting with previously acquired knowledge, what is known and what is new)	Date: Time: 2 h

How the PBL learning cycle looks like?

	Activity	Time frame
4	Structuring new content needed to solve problems and set hypotheses Defining goals and outcomes of the learning process	Date: Time: 2 h
5	Realization of the set goals and outcomes, learning, gathering information, individual learning or in pairs (reading literature, using different sources, realization of set outcomes)	Date: Time: 4 x 2h
6	Discussion and synthesis of collected information and knowledge, development of the final form, form of presentation	Date: Time: 2 x 2h
7	Reporting/ Discussion/ Evaluation	Date: Time: 3 h

Evaluation of the PBL model

Within the evaluation of the results of the PBL learning process, students declare themselves on three grounds:

1) evaluation of personal engagement
2) evaluation of engagement of other team members
3) evaluation of learning methodology, quality of literature and the role of teachers

The evaluation results will serve to objectively assess the individual contribution and further develop the PBL model.

Evaluation of the PBL model

The aim of the evaluation is **to objectively assess the contribution of each participants** and **the effects of the new learning model** on achieving the basic mission of the PBL model, namely:

1) creating learning content according to a real problem,
2) active relationship of each individual in the learning process, taking responsibility and sharing responsibility within the team
3) the ability to independently collect relevant information and exchange knowledge through the process of teamwork
4) presentation of work results.

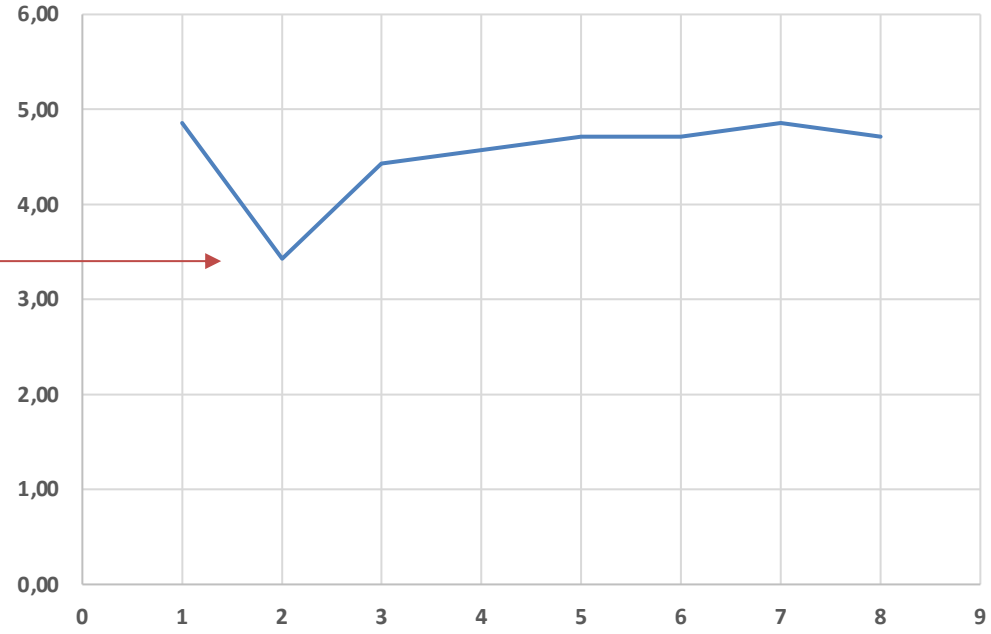
Evaluation of the PBL model

1) PBL scenario (task) quality
2) Representation and quality of literature
3) The role of the teacher
4) The quality of the PBL learning model compared to the classical model
5) PBL contributes to the development of teamwork skills
6) PBL contributes to the skill of presenting results
7) PBL contribution to work motivation
8) PBL contribution to preparation for professional work

PBL process assessment

Tab 3	Average	max	min	Questions
1	4.86	5	4	PBL scenario (task) quality
2	3.43	4	3	Learning resources
3	4.43	5	3	The role of the teacher
4	4.57	5	4	The quality of the PBL learning model compared to the classical model
5	4.71	5	4	PBL contributes to the development of teamwork skills
6	4.71	5	4	PBL contributes to the skill of presenting results
7	4.86	5	4	PBL contribution to work motivation
8	4.71	5	4	PBL contribution to preparation for professional work

Average student's grade per question



1. Higher level of motivation
2. Learning resources should be improved
3. Deeper insight to course content
4. Collaborative work make the students to be more active
5. Teacher as a tutor influence the students to be self-directive
6. PBL significantly contributes to LLL abilities

Study program: Master program - Geodesy
Year/Semester: First/First
Course: Adjustment calculus – advanced
Lecturer: BB
ECTS: 4

GEO BIZ

BUSINESS DRIVEN PROBLEM-BASED LEARNING
FOR ACADEMIC EXCELLENCE IN GEOINFORMATICS

2019-2022

HOW TO IMPLEMENT PBL INTO A LEARNING PROCESS

Practical guide

BRANKO BOZIC, PHD

Co-funded by the
Erasmus+ Programme
of the European Union

http://geobiz.eu/

By Working With PBL, Students Will:

- Get involved in situations and problems on the labour market
- Develop teamwork to determine what is known/unknown and methods of finding information and solving a given problem.
- Investigate the problem; through critical thinking and problem solving, come up with a list of unique solutions.
- Analyse the situation to see if the real problem is fixed or if there are other problems that need to be solved.

Example Problem-Based Learning & Problem Solving

Conclusion

- In PBL you decide, **together with your fellow group** members, what knowledge you will need
- Your group is **supervised and guided by a tutor or lecturer**
- You learn skills that will stand you in good stead later
- You engage actively with the subject matter, enabling you to absorb it better
- **Complex problem solving** is the number 1 skill for your future and important for the process of lifelong learning.

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Thank you for attention!

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