
Physics Education Laboratory Lecture 20 Toward the exam

Francesco Longo • 02/12/2024

Teacher's perspectives

- Subject Matter Knowledge (SMK) or Content Knowledge (CK)
- Pedagogical Knowledge (PK)
- Pedagogical Content Knowledge (PCK)
- Content Knowledge for Teaching (CKT)
- Cultural Content Knowledge (CCK)
- Technological Pedagogical Content Knowledge (TPCK)

Course Topics

Student's perspectives

- How students learn
 - Cognitive skills
 - Meta-cognitive skills
 - Assessments
 - Attitude towards physics

Physics perspectives

- Epistemological point of view/development:
 - How Physics works
 - How Physics knowledge is structured
 - How Physicists work
-

Lesson outline

Observation

- Video - lessons

Discussion

- Teacher's perspective
- Student's perspective
- Discipline's perspective

Conceptual Frame

- Content's details
- Main conceptual difficulties

Teaching Approach

- Methodologies
- Educational

Laboratory

- Educational experiments
 - Case studies
-

Main topics

Useful education tools in PER

Kinematics

Dynamics

Energy

Fluidodynamics

Calorimetry/thermodynamics

Optics

Electrostatics

Magnetism

Electromagnetism

Quantum Mechanics

Special and general relativity

Early Physics

Multiple Representations in Physics

Historical approaches

Problem-solving skills;

Jeopardy problems

Physics of everyday Thinking

Project Based Education

Modelling instruction

Simulation for Educational Physics

ISLE - Investigative Science Learning Environment

IBSE - Inquiry Based Science Education

Bayesian updating method

On line educational toolkit

Specific Learning Disorders

Electricity and Magnetism Conceptual Assessment (EMCA)

<https://drive.google.com/file/d/1pG16k-lvDqwohShthWi8MpTngtK2D8NZ/view?usp=sharing>


Project based education

BUCK INSTITUTE FOR EDUCATION

PBLworks

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What is PBL?

Project Based Learning (PBL) is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects.

The image shows a group of students in a classroom or studio setting. In the foreground, a young man with glasses is holding a professional microphone on a boom. Next to him, another young man is looking at a camera. In the center, a young woman with long, curly hair is operating a professional video camera. In the background, another student is visible, looking towards the camera. The scene is lit with studio lights, suggesting a video production or media arts project.

<https://www.pblworks.org/what-is-pbl>

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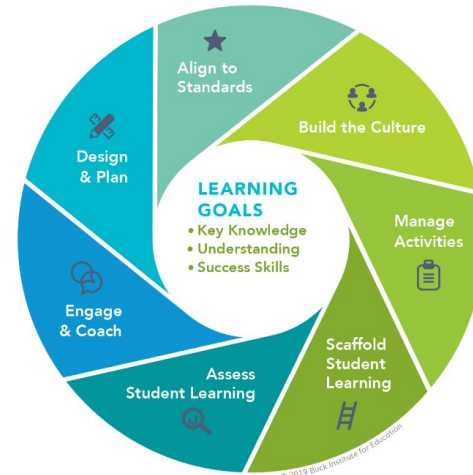
Gold Standard PBL

Seven Essential Project Design Elements



Gold Standard PBL

Seven Project Based Teaching Practices



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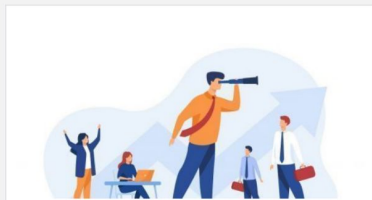
Project-Based Learning: Teaching Guide

Introduction

Project-based learning (PBL) involves students designing, developing, and constructing hands-on solutions to a problem. The educational value of PBL is that it aims to build students' creative capacity to work through difficult or ill-structured problems, commonly in small teams. Typically, PBL takes students through the following phases or steps:

1. Identifying a problem
2. Agreeing on or devising a solution and potential solution path to the problem (i.e., how to achieve the solution)
3. Designing and developing a prototype of the solution
4. Refining the solution based on feedback from experts, instructors, and/or peers

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Project Based Learning (PBL): cos'è e come funziona

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GIU

L'apprendimento basato su progetti può migliorare sensibilmente l'efficacia di un corso di formazione e amplificarne gli effetti nel contesto extra-didattico. Scopriamo come.

👤 Sonia Melilli 📁 Progettazione, Piattaforme elearning, Formazione, Buone pratiche

La **formazione tradizionale** è spesso ancorata a metodologie formative inadeguate che non forniscono agli studenti gli stimoli, i metodi e le soluzioni per applicare le nozioni apprese alla realtà extra-formativa e alle attività lavorative. Questo perché gli approcci didattici utilizzati sono ancora molto legati alla **memorizzazione meccanica di nozioni alienate dai loro usi concreti** nel mondo reale.

Ma come fare in modo che la formazione contribuisca a sviluppare l'intelligenza critica necessaria ad affrontare e risolvere le questioni complesse che si affrontano nella realtà (lavorativa e non) quotidiana?

In questo articolo analizzeremo le opportunità offerte dal **Project Based Learning (PBL)**, concentrandoci in particolare su:

- Cos'è il Project Based Learning
- I 7 elementi essenziali del Project Based Learning
- I principali vantaggi dell'apprendimento basato sui progetti

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CHAPTER 19

Project-Based Learning

Joseph S. Krajcik and Phyllis C. Blumenfeld

Learning sciences research provides a potential solution to these problems. Drawing on the cognitive sciences and other disciplines, learning scientists are uncovering the cognitive structure of deeper conceptual understanding, discovering principles that govern learning, and showing in detail that schools teach superficial knowledge rather than deeper knowledge. Drawing on this research, many learning scientists are developing new types of curricula, with the goal of increasing student engagement and helping them develop deeper understanding of important ideas. Our own contribution is articulating the features of *project-based learning* (Blumenfeld et al., 2000; Krajcik et al., 1994). Project-based learning allows students to learn by doing and applying ideas. Students engage in real-world activities that are similar to the activities that adult professionals engage in.

Project based education

Dec. 2008, Volume 5, No.12 (Serial No.49)

US-China Education Review, ISSN1548-6613, USA

Effective teaching methods —Project-based learning in physics*

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Abstract: The paper presents results of the research of new effective teaching methods in physics and science. It is found out that it is necessary to educate pre-service teachers in approaches stressing the importance of the own activity of students, in competences how to create an interdisciplinary project. Project-based physics teaching and learning seems to be one of the most effective methods for teaching science for understanding. It is necessary to provide in-service teachers instruction (seminars) and prepare sample projects with proposals how to develop, run and evaluate interdisciplinary projects. Projects are important “real-world” physics modules, modern physics and everyday life problems can be integrated into the high school curriculum. Examples of projects that were worked out are presented.

Key words: physics; teaching method; project-based learning; renewable energy; water

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Project-based learning: a review of the literature

Defining characteristics of project-based learning

Project-based learning is a student-centred form of instruction which is based on three constructivist principles: learning is context-specific, learners are involved actively in the learning process and they achieve their goals through social interactions and the sharing of knowledge and understanding (Cocco, 2006). It is considered to be a particular type of inquiry-based learning where the context of learning is provided through authentic questions and problems within real-world practices (Al-Balushi & Al-Aamri, 2014) that lead to meaningful learning experiences (Wurdinger, Haar, Hugg & Bezon, 2007). Blumenfeld, Fishman, Krajcik, Marx and Soloway (2000), for example, described the process of project-based science as follows:

'The presumption is that students need opportunities to construct knowledge by solving real problems through asking and refining questions, designing and conducting investigations, gathering, analysing, and interpreting information and data, drawing conclusions, and reporting findings' (p.150).

Project based Learning



<https://www.youtube.com/watch?v=crMM4z3oKmQ>

Course Final Exam

1. Choose a subject
 2. Choose a teaching approach
 3. Discuss the adopted teaching approach based on PER literature search
 4. Create your own educational case
 5. Elaborate a report
 6. Prepare a laboratory to test it
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Evaluation CKT - based

1. Coherence
 - Activities - Age
 - Educational Strategies
 2. Completeness
 - Pre - During - Post
 - Attention to DSA
 3. Clarity of presentation
 - Availability of material
 - Presentation
 - Description of activity
 - Discussion
-

How to?

1. Define a classroom
 - Age, Number, Learning Disorders
2. Choose a topic
 - Look at “Indicazioni Nazionali”
 - Prerequisites, Possible “pre”-instruction ideas
3. Prepare the lectures
 - Coherent pedagogical approach
 - Number of hours - Activities
 - Homework
 - Assessment (which?)
4. Prepare a laboratory to test
 - Prepare the material to guide the lectures (tables, videos, laboratory, graphs, exercises, etc)