Pathway for Innovation, Inclusion Quality (EEPIIQ)

PBL Handbook

Enhancing Entrepreneurship Education #1

Akaki Kapanadze
Fred Katongole Kasyrie

This handbook is the culmination of the Entrepreneurship Education - Pathway for Innovation, Inclusion Quality (EEPIIQ) project, which aims to enhance entrepreneurship education at Samtskhe-Javakheti State University and Caucasus University. Running from September 2023 to February 2025, the project includes key activities such as faculty development training by George Washington University, curriculum reviews, and the establishment of an Innovation and Entrepreneurship Center at SJSU. To consolidate these gains, guidelines were created to mainstream entrepreneurial education within these institutions, fostering a culture of innovation. The handbook is designed to assist professors and students in innovation and entrepreneurship modules, offering practical advice on starting, organizing, and evaluating problem-based learning (PBL).

The handbook will guide lecturers handling innovation and entrepreneurship modules at the respective universities to make them more visible to the classes they handle. It will provide advice as much as practically possible on how to start, organize and evaluate problem-based learning but will also briefly describe the advantages of this form of teaching. We hope that this short theoretical introduction will adequately explain why problem-based learning is worth trying in the university lecture rooms. The ultimate goal is to drive energy into building future ready human resources able to among others promote awareness of 21st century skills. The 21st Century skills are 12 abilities that today's students need to succeed in their careers during the Information Age. These include: - Critical thinking, Creativity, Collaboration, Communication, Information literacy, Media literacy, Technology literacy, Flexibility, Leadership, Initiative, Productivity and Social skills.

The handbook was developed by Caucasus University (CU) and Samtskhe-Javakheti State University (SJSU) within the framework of the project: Entrepreneurship Education – Pathway for Innovation, Inclusion and Quality (MES_CIF_1_22) funded by the Competitive Innovation Fund CIF (Georgia I2Q Innovation, Inclusion and Quality Competitive Innovation Fund), the international partner of which is the "Office of Innovation and Entrepreneurship (GWOIE)" of George Washington University.

Table of Contents

1.Introduction to Problem Based Learning

Section learning outcomes

By the end of this section, you should be able to:-

I. Define the concept and practice of Problem Based Learning as used in Entrepreneurship Education.
II. Distinguish between traditional teaching and Problem based learning.
III. Highlight some benefits of PBL to learners in the 21st century.
IV. Highlight the advantages of using PBL for modern time educators.
V. Highlight the key steps necessary in ensuring effective PBL?
VI. Highlight the specific roles that facilitators play in PBL?
VII. Highlight the key components of Problem Based Learning

Definition of PBL and its relevance in entrepreneurship education.

Problem-Based Learning (PBL) is a teaching method that encourages students to take the lead in their learning process. Developed at the end of the 19th century under the influence of Piaget's developmental psychology research, PBL is based on the idea that individuals construct knowledge through experience. Unlike traditional classroom settings, PBL environments are student-oriented, promoting collaboration and exploration of real-world problems. This approach shifts the focus from conveying facts to engaging in research, questioning, and active cooperation to solve challenges.

PBL is particularly relevant in entrepreneurship education as it mirrors the uncertainties and dynamic nature of the business world. By engaging students in authentic entrepreneurial problems, PBL fosters essential skills such as problem-solving, innovation, adaptability, and decision-making. These skills are crucial for aspiring entrepreneurs who must navigate the complexities of starting and running a business. Furthermore, PBL promotes a deeper understanding of entrepreneurial concepts and practices, as students learn to apply theoretical knowledge in practical, often unpredictable, situations.

Explain the benefits of PBL for students and educators

For students, PBL offers several advantages:

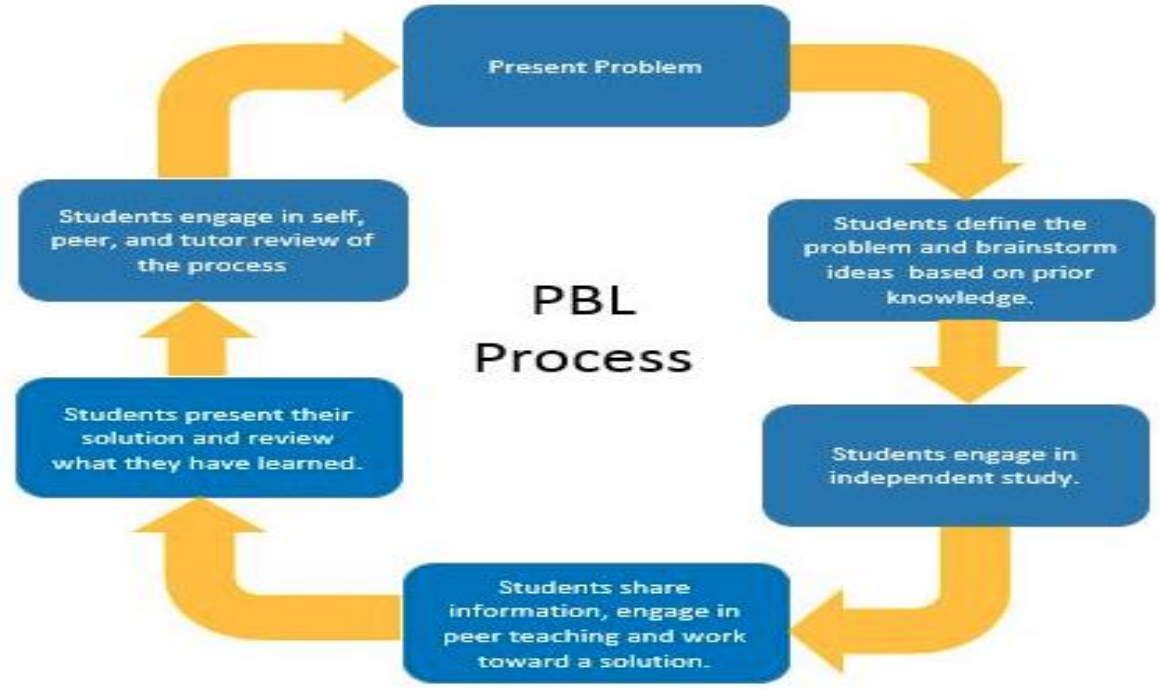
- **Enhanced Engagement:** Working on real-world problems increases motivation and interest in the subject matter.
- **Improved Critical Thinking:** Students develop critical thinking and analytical skills as they dissect problems and explore various solutions.
- **Collaborative Learning:** PBL encourages teamwork, communication, and collaboration, reflecting the collaborative nature of the business environment.
- **Practical Experience:** Students gain hands-on experience in problem-solving, preparing them for real-world entrepreneurial challenges.

For educators, PBL provides:

- **Dynamic Teaching Environment:** PBL shifts the role of the educator from a transmitter of knowledge to a facilitator of learning, making the teaching process more interactive and engaging.
- **Immediate Feedback:** Educators can assess student understanding and progress through their approach to solving problems, allowing for timely feedba support.
- **Interdisciplinary Learning:** PBL often integrates multiple disciplines, p educators with opportunities to design comprehensive, interdisciplinary l experiences.

In traditional learning environments, the focus is often on passive absorption of information, with educators delivering facts and students memorizing them. In contrast, PBL is student-centered and involves active engagement with real-world problems. This approach encourages students to take ownership of their learning, develop critical thinking skills, and collaborate with peers. PBL classrooms are dynamic spaces where students explore diverse avenues, theories, and solutions, guided by their curiosity and the need to solve authentic problems.

Overview of how PBL works and its key components.



(Source: http://www.slideshare.net/kategukeisen/problem-based-learning-basics)

Problem Based Learning Process.

PBL begins with a meaningful and realistic problem or question that aligns with the students' knowledge and maturity levels. The Professor guides students through a process of inquiry, research, and reflection, encouraging them to ask questions, gather materials, and evaluate information. The process includes the following steps:

1. **Develop a Problem:** Start with a realistic problem that interests students.
2. **Activate Existing Knowledge:** Encourage students to connect new information with what they already know.
3. **Identify Required Knowledge:** Determine what additional information is needed to solve the problem.
4. **Research:** Conduct research to gather the necessary information.
5. **Assess:** Evaluate the information and potential solutions.
6. **Share Solutions:** Present the solutions to the class or a broader audience.
7. **Reflect and Compare:** Reflect on the process and compare different solutions.
8. **Critically Analyze:** Critically analyze the results and the learning process.

Key Components of Problem-Based Learning:

1. **Authentic:** Use real-world, relevant problems that are meaningful to learners.
2. **Personalized:** Connect learning with learners' individual styles and creativity.
3. **Non-Linear:** Allow learners to explore diverse avenues, theories, ideas, and solutions.
4. **Guide and Scaffold:** Steer learners in the right direction using prompting questions and provide resources.

The Role of the Teacher in Problem-Based Learning: The role of the Professor in PBL includes:

1. **Guiding and Supporting Learners:** Help students actively construct their own learning.
2. **Allowing Learners to Lead:** Let students take the lead while providing scaffolding through observation and reflection.
3. **Personalizing Learning:** Connect with students' individual styles and creativity, offering opportunities for extension.
4. **Encouraging Multiple Directions:** Guide students through questioning and exploration.
5. **Implementing Multifaceted Assessment:** Use meaningful, connected contexts for assessment throughout the program.

Public Presentation of PBL Results: Public presentation is a key part of PBL, enhancing both the seriousness of the effort and the pedagogical impact. Students' work should be shared with peers, educators, and the community, fostering a sense of achievement and accountability. This could involve presentations to other classes, faculty members, parents, or the wider community, ensuring that students receive recognition for their efforts and learn valuable skills in public speaking and presentation.

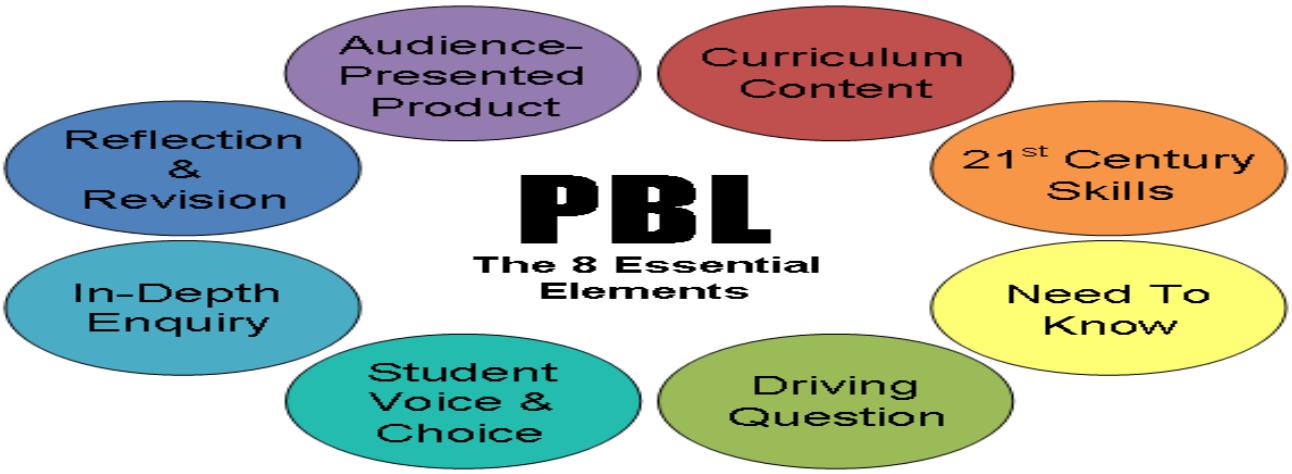
Preparation for Implementing Problem-Based Learning: Successful implementation of PBL requires thorough preparation by the Professor, who must create an environment that encourages student participation and curiosity. This involves designing engaging problems, facilitating discussions, and providing ongoing support and feedback. The goal is to foster a classroom culture where students feel comfortable sharing ideas and taking risks, ultimately leading to a more dynamic and effective learning experience.

Characteristics of Problem-Based Learning:

1. **Authentic:** Use real-world, relevant problems.
2. **Personalized:** Connect learning with individual styles and creativity.
3. **Non-Linear:** Allow exploration of diverse avenues.
4. **Guide and Scaffold:** Provide direction and resources through prompting questions.

By incorporating PBL into entrepreneurship education, institutions can create a more engaging and effective learning environment that prepares students for the complexities and challenges of the real world. This handbook aims to support educators in implementing PBL, driving innovation and fostering the development of essential 21st-century skills.

On the whole the illustration below summarizes the concept and practice of PBL, highlighting various key aspects in the entire learning process.



Section review

Define the concept and practice of Problem Based Learning?
List some benefits of PBL to learners in the 21st century.
List the advantages of using PBL for modern time educators.
Which key steps are necessary in ensuring effective PBL?
What specific roles do facilitators play in PBL?
Mention 4 key components of Problem Based Learning

2. Designing PBL Modules

Section learning outcomes

By the end of this section, you should be able to:-

I. Design a PBL module for your course through simple steps.
II. Create PBL inclined learning outcomes for each of your courses
III. Connect your content to real life scenarios to enable active learning.
IV. Design case studies that stimulate critical thinking
V. Assess a PBL session for effective learning

Designing PBL modules involves a series of steps which include the following specific one:

Identify learning objectives for each PBL module.

At the start always ask yourself what essential elements are important when designing and planning for a project-based learning opportunity?
Most resources reference 7 or 8 Essential Elements to consider when implementing project-based learning. These include:

- curriculum content (key knowledge derived from standards),
- 21st Century skills (sometimes considered "soft" skills that overlap with Maine's Guiding Principles),
- need to know (the problem or project piques student curiosity and is relatable),
- driving question (compelling, complex and open-ended question that has no single "right" answer and that guides student thinking and learning),
- student voice and choice (project allows some student choice),
- in-depth inquiry (sustained learning over time),
- reflection and revision (time to self-reflect on learning and revise product is built into the project's design), and
- audience-presented product (final product is public facing to an authentic audience).

These elements should be carefully considered when planning project-based learning. Each of these elements helps to differentiate between projects and project-based learning.

Look over every unit of study and consider the essential elements for designing and planning a project-based learning opportunity.

- Are any of these essential elements present?
- What changes might you make to incorporate any/all missing essential elements into your unit of study?

Develop real-world problems or challenges relevant to entrepreneurship.

Consider what real-world connections that can you help make/support your students to engage in during the project-based learning experience?Perhaps the most critical aspect in the launch of a successful project-based learning experience is to create the "need to know" for students through a well-crafted driving question.
As a Professor leading the course, look over your unit of study and consider the following in developing rel work problems (existent and futuristic in nature)

- Are the driving questions well structured?
- What do I intend to see out of this activity?
- How can students be aided to collect relevant information to support the output?
- Do the questions trigger entrepreneurship and innovation in any way?

Create scenarios or cases that stimulate critical thinking and problem-solving skills.

In such a dynamic world, critical thinking becomes a necessary tool to survive, and succeed in life. Students would use this skill to improve their analysis abilities and professional approach to challenges. They would develop their abilities in evidence evaluation and initiating practical solutions to problems of various nature

Therefore, deploying case studies can be an effective method to open the doors to this direction. Case studies are defined as study methods that include well documented scenarios often time profiled from real life happenings and aimed at driving particular learning outcomes such as decision making.

Irrespective of the level of teaching you are handling, be it Bachelors, Masters, PhD or a lifelong learners class, this method will enable you to boost your classes' critical thinking abilities. Case studies can be identified in various literature and case study banks in various business books.

Design assessment criteria to evaluate student performance.

Designing assessments for PBL depends on the nature of the problem being addressed. Therefore this can invite a cocktail of methods of work.Assessments can be embedded quite seamlessly throughout PBL. Thoughtful and intentional assessment methods will help you measure students' understanding and plan instruction accordingly However this handbook has a dedicated section for the same in the second guide #Book 2. That withstanding the table here below offers an idea of the diversity of available summative assessment formats that can be instrumental in this effort.

Methods	Description	Skills to be assessed	Instruments
Self-Assessment	Self-assessment involves students making judgments about their own work. (Assess their own performanc	Skills (rubric) for team work skills: - Self-contribution - Cooperation within team member - Responsibility to team members	Self-Assessment
Peer Assessment	Students are making assessment decisions on other students' work. (Assess performance their peer)	Skills for team work skills: - Team member contribution - Cooperation within team member - Responsibility to team members	Peer-Assessment
Tutor Assessment	Tutor assesses his/her students' performances and the products of the group work (report & presentation)	- Critical analysis skills - Communication skills	Group report Assessment
		- Critical skills - Problem solving skills - Self-directed learning	Individual in group activities
		- Communication skills - Collaborative work	Group Presentation:
Content Knowledge Assessment	To assess student knowledge of subject. Pre-Test; to measure students understanding on subject. Post-Test; to know student attainment in subject knowledge. (The question about subject the student comprehension)	- Subject knowledge Comprehension Skills	Pre-Test
		- Subject knowledge Comprehension Skills *(Knowledge building skills)*	Pos-Test/ Final-Test

Section review

What steps are key in designing a PBL module?

What key considerations must one put in place when creating learning outcomes for a PBL course?

Why is it important to connect learning content to real life scenarios?

Why would you use case studies in PBL?

In which different ways may a PBL session be assessed for effective learning?

3. Implementing PBL

Section learning outcomes

By the end of this section, you should be able to:-

I. Follow through the steps for introducing PBL to students and setting expectations through your sessions.
II. Appreciate and perform your role as a facilitator during a PBL class.
III. Form effective groups of students to enable collaboration.
IV. Able to guide students through a PBL research assignment.

Steps for introducing PBL to students and setting expectations.

Problem-Based Learning (PBL) is an instructional method that challenges students to "learn to learn" by engaging them in the active exploration of real-world problems. To effectively introduce PBL and set expectations, educators need to establish a structured approach that ensures students understand the purpose, process, and their roles in this learning methodology.

Step 1: Introduction to PBL
Begin by explaining the concept of PBL to students. Discuss how it differs from traditional learning methods and why it is beneficial. Highlight that PBL focuses on developing critical thinking, problem-solving, and collaborative skills by engaging with real-world issues. Example: "Unlike traditional learning, where the focus is often on memorizing facts, PBL emphasizes understanding and applying knowledge to solve real problems. This approach will help you develop skills that are crucial for your future careers."

Step 2: Clarify the Objectives
Clearly outline the learning objectives and outcomes. Make sure students understand what they are expected to achieve through the PBL process. Emphasize both the subject-specific knowledge and the skills they will develop.Example: "By the end of this project, you should be able to identify and analyze a real-world problem, research and evaluate possible solutions, and effectively communicate your findings."

Step 3: Set Clear Expectations
Establish expectations for student participation, behavior, and performance. This includes guidelines for teamwork, research, project milestones, and presentations. Be explicit about the criteria for assessment and how each component of the project will be graded.Example: "Participation in team meetings, consistent effort in research, meeting

project deadlines, and active contribution to the final presentation are essential. Your grade will reflect your engagement and the quality of your work."

Step 4: Formulate the Problem
Introduce the problem or scenario that will be the focus of the PBL project. Ensure that the problem is relevant, challenging, and appropriate for the students' level of knowledge. Provide context and background information to help them understand the significance of the issue.Example: "The problem we will be addressing is the increasing levels of pollution in our city's river. You will need to investigate the sources of pollution, its impact on the environment and community, and propose feasible solutions."

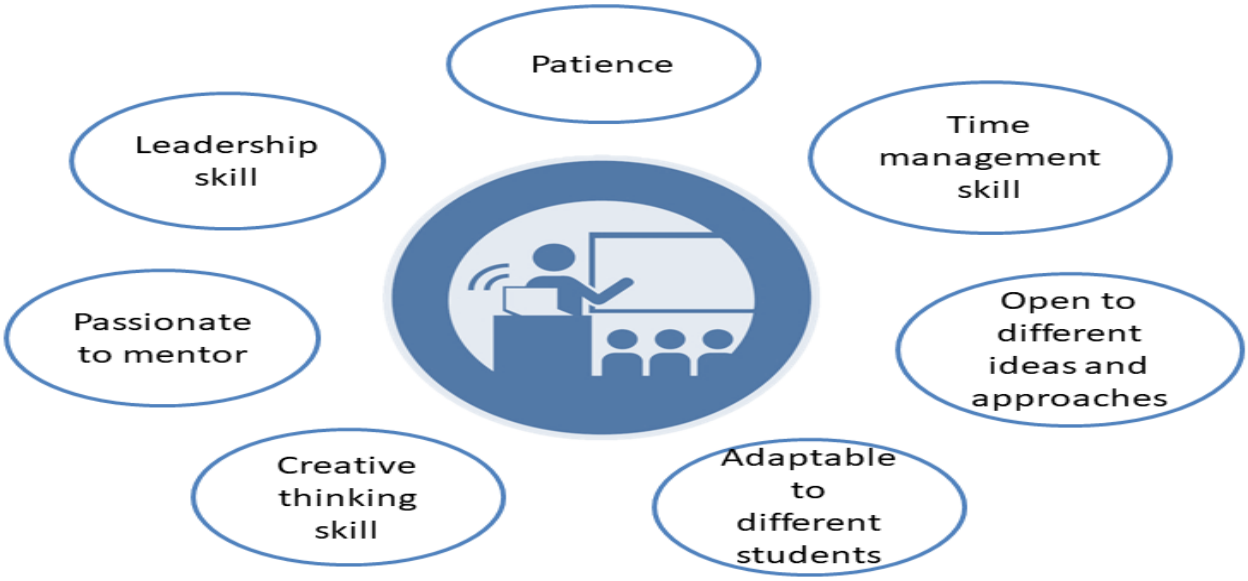
Step 5: Organize Resources and Tools
Provide students with access to the necessary resources and tools. This includes research materials, access to databases, software for project management, and any other tools that will facilitate their work. Offer guidance on how to use these resources effectively.Example: "You will have access to the university's online databases, environmental reports, and project management software. Tutorials on using these resources will be available on our course webpage."

Step 6: Develop a Timeline
Create a detailed timeline for the PBL project with specific milestones and deadlines. This will help students manage their time effectively and stay on track. Include time for research, group meetings, progress reviews, and final presentations.Example: "Your project timeline will include initial research (weeks 1-2), problem analysis (weeks 3-4), solution exploration (weeks 5-6), and final presentations (week 8). Regular check-ins will ensure you are progressing as planned."

Step 7: Encourage Reflection and Feedback
Incorporate opportunities for students to reflect on their learning process and receive feedback. This can be through journals, group discussions, and periodic reviews. Encourage them to think critically about their approach and how they can improve.Example: "At the end of each week, you will submit a brief reflection on what you have learned and any challenges you faced. This will help you track your progress and adapt your strategies as needed."

Introducing PBL requires careful planning and clear communication. By setting clear expectations and providing structured support, educators can help students successfully navigate the PBL process and develop valuable skills that will benefit them in their academic and professional lives.

The role of the educator as a facilitator in PBL.



In Problem-Based Learning (PBL), the role of the educator shifts from being a traditional instructor to a facilitator. This transformation is crucial for fostering an environment where students can engage deeply with the material, collaborate with peers, and develop their problem-solving abilities.

A. Guide on the Side : As a facilitator, the educator's primary role is to guide rather than direct. This involves providing support, resources, and encouragement, allowing students to take ownership of their learning process. Example: "Instead of giving you direct answers, I will ask questions that will help you think more deeply about the problem and explore various solutions."
B. Creating a Supportive Environment: Facilitators create a classroom atmosphere that encourages open communication, risk-taking, and mutual respect. This environment is essential for effective collaboration and exploration.Example: "Our classroom is a safe space for sharing ideas and asking questions. Respect for each other's opinions and contributions is paramount."
C. Encouraging Inquiry: Facilitators encourage students to ask questions and pursue their curiosity. This involves modeling inquisitive behavior and demonstrating how to approach problems systematically.Example: "Think about what you need to know to solve this problem. What questions do you need to answer first? Let's brainstorm some possible questions together."
D. Providing Resources: Educators as facilitators ensure that students have access to the resources they need to succeed. This includes research materials, technological tools, and expert contacts.Example: "Here are some articles and

websites that might be helpful for your research. You can also reach out to the local environmental agency for more information."

E. Monitoring Progress: Facilitators regularly check in with students to monitor their progress, provide feedback, and offer guidance. This helps keep the project on track and addresses any issues that arise.Example: "How is your group progressing with the research phase? Are there any challenges you are facing that I can help with?"
F. Encouraging Collaboration: Effective facilitators foster teamwork by encouraging collaboration and communication among students. They help resolve conflicts and ensure that all group members are actively engaged.Example: "It seems like there's a disagreement about the next steps. Let's have a group discussion to find a compromise that everyone can agree on."
G. Promoting Critical Thinking: Facilitators challenge students to think critically about their assumptions, methods, and conclusions. This involves asking probing questions and encouraging reflective thinking.Example: "Why do you think this solution will work? What are the potential limitations or downsides? Can you think of any alternatives?"
H. Supporting Reflection: Reflection is a key component of PBL. Facilitators help students reflect on their learning process, the strategies they used, and the outcomes they achieved.Example: "Take a few minutes to write down what you learned from this week's activities. How did your understanding of the problem change? What would you do differently next time?"
I. Balancing Guidance and Independence: One of the most challenging aspects of facilitation is finding the right balance between providing guidance and allowing students to work independently. Facilitators must know when to step in and when to step back.Example: "I can see you're struggling with this part of the project. Would you like some suggestions, or would you prefer to try solving it on your own for a bit longer?"

The role of the educator in PBL is multifaceted and dynamic. As facilitators, educators must create a supportive learning environment, encourage inquiry and collaboration, monitor progress, and promote critical thinking and reflection. By doing so, they help students become independent learners who are capable of tackling complex problems with confidence and creativity.

Guidelines for group formation and collaboration among students.

Effective group formation and collaboration are critical components of Problem-Based Learning (PBL). The success of a PBL project often hinges on how well students work together to solve problems. This section provides guidelines for forming groups and fostering productive collaboration.

A. Consider Diversity: Form groups that include students with diverse backgrounds, skills, and perspectives. This diversity enriches the problem-solving process and encourages creative thinking. Example: "When forming your groups, aim for a mix of different majors, skill sets, and cultural backgrounds. This will bring a variety of viewpoints to your discussions."

B. Set Group Size: Optimal group size is usually between 4-6 members. This size is manageable and allows for a range of perspectives without becoming too unwieldy. Example: "Each group should consist of 4-6 students. This size will ensure everyone has a chance to contribute and collaborate effectively."

C. Define Roles and Responsibilities: Clearly define roles within each group to ensure that all members contribute and responsibilities are evenly distributed. Roles can include a leader, researcher, recorder, presenter, and timekeeper. Example: "Each group member should take on a specific role, such as team leader, researcher, or presenter. These roles will help you stay organized and ensure everyone is involved."

D. Establish Group Norms: Develop group norms or rules to guide interactions and ensure respectful, productive collaboration. Norms should cover communication, conflict resolution, and decision-making processes.Example: "Agree on some group norms, like how often you'll meet, how you'll communicate, and how you'll handle disagreements. These norms will help you work together smoothly."

E. Foster a Sense of Ownership: Encourage students to take ownership of their group's success. This involves setting common goals, making joint decisions, and holding each other accountable. Example: "As a group, set your own goals for the project and decide how you'll measure your progress. This will help you stay motivated and committed."

F. Guidelines for Collaboration: Facilitate Effective Communication. Effective communication is the cornerstone of successful collaboration. Encourage open, honest, and respectful communication within.

Methods for guiding student research and exploration of solutions.

Problem-Based Learning (PBL) requires students to engage deeply with research and explore solutions to real-world problems. Educators play a crucial role in guiding this process to ensure that students develop the necessary skills and achieve meaningful outcomes. This section provides methods for effectively guiding student research and exploration of solutions in a PBL context.

A. Setting Clear Research Objectives

Define the Problem: Ensure students have a clear understanding of the problem they are addressing. Define the scope and parameters of the problem to guide their research efforts. Example: "The issue we are addressing is urban water pollution. Focus on identifying the main sources of pollution, its impact on the community, and potential mitigation strategies."

Break Down the Problem: Encourage students to break down the problem into smaller, manageable parts. This helps them identify specific research areas and organize their

efforts systematically.Example: "Divide the problem into sections such as water quality assessment, pollution sources, effects on public health, and regulatory measures."

B. Developing a Research Plan

Create a Research Timeline: Guide students in developing a research timeline that includes key milestones and deadlines. This helps them stay on track and manage their time effectively.Example: "Your research timeline should include deadlines for literature review, data collection, analysis, and final report preparation. Make sure to allocate enough time for each phase."

Identify Research Methods: Discuss various research methods that can be used, such as literature reviews, surveys, experiments, and case studies. Help students choose appropriate methods based on the nature of the problem.Example: "For assessing water quality, you might conduct lab tests or field surveys. For understanding community impact, consider using surveys or interviews."

3. Guiding Information Gathering

Provide Access to Resources: Ensure students have access to necessary research resources, including databases, journals, books, and online tools. Provide guidance on how to use these resources effectively.

Example: "Here are some recommended databases and journals for environmental science research. We will also have a session on how to conduct effective online searches."

Teach Information Literacy: Equip students with skills to critically evaluate sources of information. Discuss the importance of credibility, reliability, and relevance when gathering data.Example: "Evaluate your sources by checking the author's credentials, publication date, and the credibility of the publishing organization. Always cross-check information from multiple sources."

4. Encouraging Exploration and Innovation

Foster a Culture of Inquiry: Encourage students to ask questions and explore multiple perspectives. Promote an environment where curiosity and creativity are valued.

Example: "Think about the problem from different angles. What are the less obvious factors contributing to water pollution? How might innovative technologies be used to address it?"

Use Brainstorming Sessions: Organize brainstorming sessions to generate ideas and explore potential solutions. Encourage free-flowing discussion and creative thinking.

Example: "Let’s have a brainstorming session where we list all possible solutions to reduce water pollution. No idea is too outlandish at this stage—let’s think creatively!"

5. Supporting Data Collection and Analysis
Provide Tools and Techniques: Introduce students to various tools and techniques for data collection and analysis, such as surveys, statistical software, and laboratory equipment.Example: "We will be using SPSS for statistical analysis. I’ll provide a tutorial on how to input data and run basic analyses. For lab tests, ensure you follow the safety protocols outlined."

Guide Interpretation of Results: Help students interpret their research findings. Discuss how to analyze data critically and draw meaningful conclusions.
Example: "Look at your survey results and identify any significant patterns or correlations. What do these findings suggest about the main sources of water pollution in our city?"

6. Facilitating Solution Exploration
Encourage Prototyping and Testing: For problems that involve creating physical or digital solutions, encourage students to develop prototypes and test their ideas. Provide support for iterative testing and refinement.Example: "If you are designing a water filtration device, create a prototype and test its effectiveness. Record the results and make improvements based on your findings."

Promote Collaboration with Experts: Facilitate connections with industry experts, researchers, and practitioners who can provide insights and feedback on student projects.Example: "We have arranged a virtual meeting with an environmental scientist who works on water pollution control. Prepare your questions in advance to make the most of this opportunity."

7. Encouraging Reflection and Revision
Implement Reflective Practices: Incorporate reflective practices such as journals, peer reviews, and group discussions to help students evaluate their progress and learn from their experiences. Example: "Keep a reflective journal where you document your research journey, challenges faced, and lessons learned. We will also have peer review sessions to provide constructive feedback."

Guide Iterative Improvement: Encourage students to view their projects as iterative processes. Emphasize the importance of continuous improvement based on feedback and new insights.Example: "After testing your initial solution, gather feedback and make necessary adjustments. This iterative process is key to developing effective and robust solutions."

Guiding student research and exploration of solutions in PBL requires a structured yet flexible approach. By setting clear objectives, providing access to resources, fostering a culture of inquiry, and supporting data collection and analysis, educators can help students navigate the complexities of PBL. Encouraging reflection and iterative improvement further enhances the learning experience, ensuring that students develop critical skills and achieve meaningful outcomes.

Section review

Which different steps can an instructor use to introduce PBL to students and set the right expectations through their session.

What are the roles of a facilitator during the implementation of a PBL class.

What steps can a facilitator use to form effective groups of students to enable collaboration during PBL.

What keys aspects should a facilitator put into consideration when guiding students through a PBL research assignment.

4. Assessment and Feedback

Section learning outcomes

By the end of this section, you should be able to:-

I. Identify and use different strategies for assessing student learning in PBL.
II. Create the rubric for assessing an essay from a PBL assignment..
III. Understand the importance of timely feedback to students undertaking PBL courses.

Strategies for assessing student learning in PBL, such as rubrics and peer evaluation.

A rubric is a type of scoring guide that assesses and articulates specific components and expectations for an assignment. Rubrics can be used for a variety of assignments: research papers, group projects, portfolios, and presentations.

Information about student learning can be assessed through both direct and indirect measures. Direct measures may include homework, quizzes, exams, reports, essays, research projects, case study analysis, and rubrics for oral and other performances.

During the PBL assessment step, evaluate the groups' products and performances. Use rubrics to determine whether students have clearly communicated the problem, background, research methods, solutions (feasible and research-based), and resources, and to decide whether all group members participated meaningfully.

The following are some of the ways to effect such assessment:-

I. Direct observation. With direct observation, the teacher observes small groups or pairs of learners working on a task. ...
II. Questioning.
III. Feedback.
IV. Self-assessment.
V. Peer-assessment.
VI. The formative use of summative assessment.

How to Create a Rubric:

Introduction

Perhaps you have never even thought about the care it takes to create a rubric. Perhaps you have never even *heard* of a rubric and its usage in education, in which case, you should take a peek at this article: "What is a rubric?" Basically, this tool that teachers and professors use to help them communicate expectations, provide focused feedback, and grade products, can be invaluable when the correct answer is not as cut and dried as Choice A on a multiple choice test. But creating a great rubric is more than just slapping some expectations on a paper, assigning some percentage points, and calling it a day. A good rubric needs to be designed with care and precision in order to truly help teachers distribute and receive the expected work.

Steps to Create a Rubric

The following six steps will help you when you decide to use a rubric for assessing an essay, a project, group work, or any other task that does not have a clear right or wrong answer.

Step 1: Define Your Goal

Before you can create a rubric, you need to decide the type of rubric you'd like to use, and that will largely be determined by your goals for the assessment.

Ask yourself the following questions:

1. How detailed do I want my feedback to be?
2. How will I break down my expectations for this project?
3. Are all of the tasks equally important?
4. How do I want to assess performance?
5. What standards must the students hit in order to achieve acceptable or exceptional performance?
6. Do I want to give one final grade on the project or a cluster of smaller grades based on several criteria?
7. Am I grading based on the work or on participation? Am I grading on both?

Once you've figured out how detailed you'd like the rubric to be and the goals you are trying to reach, you can choose a type of rubric.

Step 2: Choose a Rubric Type

Although there are many variations of rubrics, it can be helpful to at least have a standard set to help you decide where to start. Here are two that are widely used in teaching as defined by the University:

1. **Analytic Rubric**: This is the standard grid rubric that many teachers routinely use to assess students' work. This is the optimal rubric for providing clear, detailed feedback. With an analytic rubric, criteria for the students' work is listed in the left column and performance levels are listed across the top. The squares inside the grid will typically contain the specs for each level. A rubric for an essay, for example, might contain criteria like "Organization, Support, and Focus," and may contain performance levels like "(4) Exceptional, (3) Satisfactory, (2) Developing, and (1) Unsatisfactory." The performance levels are typically given percentage points or letter grades and a final grade is typically calculated at the end. The scoring rubrics for the ACT and SAT are designed this way, although when students take them, they will receive a holistic score.
2. **Holistic Rubric:** This is the type of rubric that is much easier to create, but much more difficult to use accurately. Typically, a teacher provides a series of letter grades or a range of numbers (1-4 or 1-6, for example) and then assigns expectations for each of those scores. When grading, the teacher matches the student work in its entirety to a single description on the scale. This is useful for grading multiple essays, but it does not leave room for detailed feedback on student work.

Step 3: Determine Your Criteria

This is where the learning objectives for your unit or course come into play. Here, you'll need to brainstorm a list of knowledge and skills you would like to assess for the project. Group them according to similarities and get rid of anything that is not absolutely critical. A rubric with too much criteria is difficult to use! Try to stick with 4-7 specific subjects for which you'll be able to create unambiguous, measurable expectations in the performance levels. You'll want to be able to spot the criteria quickly while grading and be able to explain them quickly when instructing your students. In an analytic rubric, the criteria are typically listed along the left column.

Step 4: Create Your Performance Levels

Once you have determined the broad levels you would like students to demonstrate mastery of, you will need to figure out what type of scores you will assign based on each level of mastery. Most ratings scales include between three and five levels. Some teachers use a combination of numbers and descriptive labels like "(4) Exceptional, (3)

Satisfactory, etc." while other teachers simply assign numbers, percentages, letter grades or any combination of the three for each level. You can arrange them from highest to lowest or lowest to highest as long as your levels are organized and easy to understand.

Step 5: Write Descriptors for Each Level of Your Rubric

This is probably your most difficult step in creating a rubric. Here, you will need to write short statements of your expectations underneath each performance level for every single criteria. The descriptions should be specific and measurable. The language should be parallel to help with student comprehension and the degree to which the standards are met should be explained.

Again, to use an analytic essay rubric as an example, if your criteria was "Organization" and you used the (4) Exceptional, (3) Satisfactory, (2) Developing, and (1) Unsatisfactory scale, you would need to write the specific content a student would need to produce to meet each level.

Step 6: Revise Your Rubric

After creating the descriptive language for all of the levels (making sure it is parallel, specific and measurable), you need to go back through and limit your rubric to a single page. Too many parameters will be difficult to assess at once, and may be an ineffective way to assess students' mastery of a specific standard. Consider the effectiveness of the rubric, asking for student understanding and co-teacher feedback before moving forward. Do not be afraid to revise as necessary. It may even be helpful to grade a sample project in order to gauge the effectiveness of your rubric. You can always adjust the rubric if need be before handing it out, but once it's distributed, it will be difficult to retract.

The importance of timely feedback and ways to provide constructive feedback to students.

Providing constructive feedback to individual students, encouraging them to engage in and reflect upon the learning process, leads to positive learning outcomes and achieves results. How the feedback is given matters more than how much feedback is given.

When giving feedback, address challenges and solutions related to assessing group projects in PBL. The following are some of the rules of thumb that can improve the effectiveness of feedback. Feedback needs to be:

I. descriptive and not judgmental
II. specific, directed at concrete behavior

III. useful for the receiver

IV. not only negative: positive feedback stimulates the receiver to show the

V. positive behavior more frequently

VI. delivered from the perspective of the feedback provider

PRESENTATION EVALUATION FORM: (check one)						
On a scale of 1 to 5, where 1 = strongly disagrees, 2 = disagrees, 3 = n/a, 4 = agree, and 5 = strongly agrees						
Content Understanding and Relevance:	How well the student understands the topic and presents information that is accurate, relevant, and aligns with the presentation's objectives.					
		1	2	3	4	5
Organization and Structure:	The clarity and logical flow of the presentation, including the introduction, body, and conclusion, as well as how well the student transitions between points.					
		1	2	3	4	5
Delivery and Communication Skills:	The student's ability to communicate effectively, including eye contact, body language, voice clarity, pace, and engagement with the audience.					
		1	2	3	4	5
Use of Visual Aids and Supporting Materials:	The quality and effectiveness of visual aids (e.g., slides, charts) in enhancing the presentation and supporting key points.					
		1	2	3	4	5
Critical Thinking and Analysis:	The student's ability to analyze information, provide insights, and offer original thoughts or perspectives on the topic.					
		1	2	3	4	5

Section review

Identify and explain the different strategies for assessing student learning in PBL.

How can one create rubric for assessing an essay from a PBL assignment..

What is the importance of timely feedback to students undertaking PBL courses.

5. Scaling PBL for Different Settings

Section learning outcomes
By the end of this section, you should be able to:-

I. Scale PBL for different class sizes(small to big, big to small).
II. Integrate PBL within an existing curriculum.
III. Use blended and online tools in PBL

Insights on adapting PBL for different class sizes and educational contexts.

At the bare minimum, PBL requires that professors take up the role of facilitator/ mentor/ coach. This is similar to the role we assume as a supervisor of graduate research students. It comes in many different forms, regardless of the form, usually small-group, self-directed, it embodies most, if not all, of the following nine fundamental principles. The general principles are given by Chickering and Gamson (1987) with additions from Ramsden (1982), Novak (1989), these include: -

A. Students must be actively involved in the learning activities; not passively listening to the professor,
B. Students should work cooperatively together to help each other learn,
C. Provide learning activities that exploit the students' unique learning preference. Not all students learn the same way. Each has a preferred style,
D. Students should have clear goals and criteria to tell them when the goals have been achieved,
E. Students should get prompt feedback about their performance. It is not that useful to give them back a marked report three weeks after it was completed, more instant feedback is necessary,
F. Empower the students to have some role in the assessment,
G. Provide a work environment that expects that they will succeed. Learn and use their names; take a personal interest in each student. (As opposed to one where you communicate that your role is to "weed them out," "cover material," "satisfy

tough standards," "do my thing without getting personally involved with the students," or "do my thing because the real reason is to do research

H. Provide rich tutor-student interaction through many different types of in-class and outside class events.

I. Don't expect "processing skills" to be developed by providing "opportunities." Asking students to work in groups does not necessarily develop good group skills; asking students to solve problems does not necessarily develop problem solving skills. Therefore, to improve learning we should: Create an environment that embodies and uses as many of these principles as we can.

The class size and the amount of resources available are, to many instructors, major impediments to moving toward PBL. They need not be. Must there be tutors with each group? Notably, different colleges adopt different models with regard to tutor: student ratio. If we want to use PBL in our class and we are starting alone, we may not be able to provide a tutor for each group. We could: empower the groups to function without a tutor, and thus, the student group members learn skills in facilitating the group, task, problem solving and learning process. The tutor's role is one of creating the environment and monitoring, at a distance, key milestone activities of the group. They have to be a wandering tutor. The tutor wanders among the groups and, upon invitation, becomes a temporary group member to facilitate the process.

NB: The processing issues that the groups face if they are tutorless are completely different from those faced by tutored groups.

Discuss ways to integrate PBL into existing entrepreneurship curricula or courses.

As Part of the EEPIIQ Project CU and SJSU has conducted activities to integrate entrepreneurship elements and PBL into various curricula currently in use in universities in question. There are following ways to integrate PBL into the curricula:

Project-Centric Learning: PBL can be incorporated by shifting the focus of coursework from traditional lectures to real-world problems. For entrepreneurship, this can mean structuring the course around real business challenges, such as developing startups or solving local business issues. When the existing course already emphasizes practical skills like market research and business strategies, these can be expanded into full-scale PBL scenarios, where students collaboratively address a complex entrepreneurial problem from start to finish.

Case Study and Group Work: The use of case studies and group projects aligns well with PBL, where students can tackle actual entrepreneurial challenges in teams. Each group can be tasked with solving a different real-world problem, enabling peer learning and dynamic engagement.

Active Student Involvement: Courses should emphasize hands-on, student-driven inquiry. For example, rather than providing direct answers, instructors could guide students in exploring viable solutions for developing business models, managing startups, or innovating within existing enterprises. This allows students to apply theory to practice and enhances critical thinking.

Assessment Modifications: Modify assessments to evaluate students' problem-solving processes and practical outputs. An existing framework for student presentations and projects can be expanded by evaluating how students define problems, research solutions, and implement their business ideas, rather than just assessing final exams.

Real-World Partnerships: Collaboration with local businesses or startup incubators can enhance PBL. Students can work on actual business challenges, and stakeholders can provide feedback, making the learning experience both relevant and impactful.

An exploration of the potential for online or blended learning environments in PBL implementation.

To successfully use PBL in an online or hybrid lectures, consider these four tips:-

1. Be Mindful of the Devices Students Are Using

2. Use Video Conferencing Platforms for Meaningful Collaboration to ensure teamwork and collaboration

3. Make Group Work Effective with Project Management Tools in order to drive student engagement

4. Provide Ongoing Feedback and Promote Reflection on a regular basis so that students can share their wins and challenges.

Section review

By the end of this section, you should be able to:-

How can one scale PBL for different class sizes(small to big, big to small)?
Which steps can be used to Integrate PBL within an existing curriculum?
How can blended and online tools be used in PBL?

6. Useful Tools and Materials

A Segment Buying Ecosystem Worksheet

is a strategic tool used in marketing and sales to analyze and understand the dynamics of how a specific customer segment makes purchasing decisions. This worksheet helps identify all the key players, influences, and steps involved in the buying process for a target market segment. It provides a comprehensive view of the ecosystem surrounding a purchase, including direct customers, influencers, decision-makers, and other stakeholders.

Description or Title	If a consumer, define the person as completely as possible, demographically, behaviorally, or other as appropriate. If a business customer, define the person's position or role in their company. If they are indirectly impacting a situation, i.e., an influencer/recommender, talk about who they are and why and how the influence, e.g., IT manager charged with investigating compatibility of the proposed solution.
Hypotheses	*What are your key assumptions about the archetype in question? What "Job" do you assume they're fulfilling? How do you assume they'll behave? Think about motivation, information required, etc. Any assumptions that you feel can help us understand that person and your business issue.*
Interviews	*How many interviews have you conducted with this archetype? Don't worry if the number's low, we want both you and the teaching team to know where your focus has been.*
Findings/Questions	*What have you learned from your interviews? If you have not interviewed an archetype and do not have findings, what would you like to learn? What do you plan to ask?*

Segment:				
Archetype	***Description or Title***	***Hypotheses***	***Interviews***	***Findings/Questions***
User		•		•
Influencer		•		•
Recommender		•		•
Decision-maker		•		•
Economic Buyer		•		•
Saboteur		•		•

A Customer Discovery Interview Report Form

is a structured document used to record and analyze insights gained from customer discovery interviews. These interviews are conducted to gather qualitative data about potential customers' needs, pain points, preferences, and behaviors. The form helps in systematically capturing feedback and observations, ensuring that critical information is not overlooked and can be easily reviewed and shared with team members.

Team Name: **Date:**

Student Name:

Interview Subject's Name:

Interview Subject's Title:

Interview Subject Organization/Company:
Customer Segment (Be very specific):

Customer Archetype (Circle all that apply):

User | Influencer | Recommender | Decision Maker | Economic Buyer | Saboteur | Other

Key Hypotheses to Test (Can be validated or invalidated):

1.
2.
3.

What information do you need to learn to validate or invalidate the hypotheses?

1.
2.
3.

High-Level Questions: What are the questions that will help you get your interview started? (Small questions will be guided by your interviewees responses):

1.
2.
3.

What were your key insights from the interview?

Notes:

Segment Definition Builder: Consumer

Much like when you search for a car or hotel online, defining a customer segment involves applying a number of "filters" to create a detailed profile of your hypothetical customer. On the form below, enter all filters that apply to your customer segment hypothesis. After providing the applicable filters, write a short description of your customer using the most important filter descriptions.

Demographics		
Category	**Filter**	**Notes**
Age		
Sex		
Marital Status		
Family Life Cycle		
Income		
Occupation		
Education		
Race		
Geography (region, country, climate, urban, rural):		

Psychographics What else defines the customer?		
Category	**Filter**	**Notes**
Social Class		
Lifestyle (Active, strait-laced, edgy)		
Personality(Ambitious gregarious, status conscious, etc.)		

Behavioral How, when or why does the customer use your product**?**		
Category	**Filter**	**Notes**
Use Occasion (Everyday, special occasion)		
Key Desired Benefit (Quality, service, price)		
Influences, Info sources (Social Media, Celebrities, News)		
Other		

Segment Definition Now write a short definition of your segment using the filters you filled in. Remember, just the most important!
Definition:

Call Planning Worksheet

A Call Planning Worksheet is a tool used to prepare for and organize business calls, ensuring that all key points are covered and the conversation is productive. This worksheet helps in setting clear objectives, identifying important discussion topics, and anticipating potential questions or concerns from the other party. It serves as a guide to keep the call focused and aligned with the desired outcomes.

	Name of Potential Interviewee	Job/Position Title	Company/ Organization Name	LinkedIn Profile (add link)	Primary Email Address	Other Contact Information (I.e., phone, 2nd email address, etc.)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						

More resources can be found at: https://cu.edu.ge/en/grant-projects/ongoing-projects/cif-grant-project/eepiiq-grant-project

7. References

Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011). Does discovery-based instruction enhance learning? Journal of Educational Psychology, 103(1), 1–18. http://doi.org/10.1037/a0021017

Barrows, H., & Tamblyn, R. (1980). Problem-based learning: An approach to medical education. New York: Springer Publishing Company.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18(1), 32–42. http://doi.org/10.3102/0013189X018001032

Ertmer, P. A., & Koehler, A. A. (2014). Online case-based discussions: Examining coverage of the afforded problem space. Educational Technology Research and Development, 62(5), 617–636. http://doi.org/10.1007/s11423-014-9350-9

Ertmer, P. A. , & Simons, K. D. (2006). Jumping the PBL implementation hurdle: Supporting the efforts of K–12 Teachers. Interdisciplinary Journal of Problem-Based Learning, 1(1). http://dx.doi.org/10.7771/1541-5015.1005

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? Educational Psychology Review, 16(3), 235–266.

Hung, W. (2011). Theory to reality: A few issues in implementing problem-based learning. Educational Technology Research and Development. http://doi.org/10.1007 /s11423-011-9198-1

Nilson, L. B. (2010). *Teaching at its best: A research-based resource for college instructors* (2nd ed.). San Francisco, CA: Jossey-Bass.