

Active Learning Strategies Catalog

In the development of this work, initial ideas and drafts were provided by OpenAI's ChatGPT, which were extensively modified and expanded upon by Jared Campbell. He can be reached at jared@fit.edu for any questions.

Active learning, a student-centered approach, emphasizes the importance of engaging students directly in the learning process, fostering deeper understanding, critical thinking, and retention of knowledge. Within these pages, you will find a diverse array of activities designed to suit different classroom settings, learning objectives, and subject matters. Whether you are looking to introduce a brief interactive element into your lecture or engage students in a comprehensive project, this guide offers practical solutions to transform your teaching and enrich your students' learning experiences. As you explore these strategies, consider how they can be adapted and integrated into your curriculum to meet the unique needs of your students and achieve your educational goals.

This document serves as a guide to implementing active learning strategies across various time frames, ranging from quick 10-minute exercises to more elaborate 50-minute sessions. Some of the strategies can be conducted over multiple sessions. Please use this guide as inspiration for creating student centered classroom experiences.

Table of Contents

<i>Quick Glance Guide</i>	3
<i>10 Minute Strategies:</i>	4
Think-Pair-Share	4
One-Minute Paper	4
Two Truths and a Lie	4
Polling	4
Correct the Error	5
<i>20 Minute Strategies:</i>	5
Jigsaw Discussion	5
Case Study Analysis	5
Peer Teaching	6
Solution Swap	6
Gallery Walk	7
<i>30 Minute Strategies:</i>	7
Buzz Groups	7
Fishbowl Discussion	7

Concept Mapping	8
Debate.....	8
Structured Problem Solving	8
<i>40 Minute Strategies:</i>	9
Quickish PBL	9
Student-Led Seminars	9
Case Study Exploration	10
Socratic Seminar	10
Design Challenge	10
<i>50 Minute Strategies:</i>	11
In-Depth Lab Experiments.....	11
Extended Project Work.....	11
Full-Class Debate.....	11
Interactive Workshops	12
Round Robin Sessions	12
<i>Problem-Based Learning (PBL):</i>	13
Sample PBL Assignment Brief:	14
Sample Project Based Learning Rubric:	15
<i>Case Studies:</i>	16
Example Case Study Assignment:	17
Example case study rubric:	18
<i>Reflection Journals</i>	19
Sample Reflection Journal Rubric	20
<i>Peer Feedback Assignment</i>	21
Sample Rubric for Peer Feedback.....	21
Sample Direct Observation of Student Learning Rubric	22
Startup Simulation Game:.....	23
<i>Reflection Activities</i>	24
Learning Map Reflection Activity:.....	24

Quick Glance Guide

10-Minute Activities

1. **Think-Pair-Share:** Pose a question, give students a minute to think, another minute to discuss with a partner, and then share with the class. Pro-tip: Use a timer for the Think part, use a timer for the Pair part, and use a predetermined signal (chime, visual cue, etc) to end each part before sharing.
2. **One-Minute Paper:** Ask students to write a quick response to a specific question or a summary of the lesson, then discuss a few responses.
3. **Two Truths and a Lie:** students create and share two true statements and one false statement about recent course material, challenging their peers to identify the falsehood and reinforcing their understanding through discussion.
4. **Polling:** Use tools like Poll Everywhere, or hand signals to conduct a quick poll on a concept or opinion.
5. **Correct the Error:** Present students with statements, calculations, or scenarios that intentionally contain mistakes, and asking them to identify and correct these errors to reinforce their understanding of the subject matter.

20-Minute Activities

1. **Jigsaw Discussion:** Divide the class into groups, each studying a different aspect of a topic, then reforming into new groups to teach each other.
2. **Case Study Analysis:** Brief analysis of a case study with guided questions.
3. **Peer Teaching:** Students prepare short presentations to teach a concept to their peers.
4. **Solution Swap:** students work on solving a problem then exchange their solutions with peers for additional insights, fostering collaborative enhancement and critical evaluation of diverse problem-solving approaches.
5. **Gallery Walk:** Students circulate around the room to view and discuss posters or stations of content.

30-Minute Activities

1. **Buzz Groups:** Tackle a complex problem in small groups, then present solutions.
2. **Fishbowl Discussion:** An inner circle discusses a topic while the outer circle observes, then roles are switched.
3. **Concept Mapping:** Create visual maps of the relationships between concepts.
4. **Debate:** Organize a structured debate on a relevant issue.
5. **Structured Problem Solving:** students collaboratively analyze a real-world problem, brainstorm solutions, and present a strategic plan for resolution, fostering critical thinking and application of course concepts.

40-Minute Activities

1. **Project-Based Learning:** Small groups work on a mini-project or a component of a larger project.
2. **Student-Led Seminars:** Students lead the class discussion on a particular topic.
3. **Case Study Exploration:** In-depth analysis and discussion of a case study.
4. **Socratic Seminar:** A student-facilitated discussion based on Socratic questioning techniques.
5. **Design Challenge:** Students work on designing a solution to a real-world problem.

50-Minute Activities

1. **In-Depth Lab Experiments:** Conducting and analyzing laboratory experiments or detailed simulations.
2. **Extended Project Work:** Progression on long-term projects, with checkpoints for discussion and feedback.
3. **Full-Class Debate:** A comprehensive debate covering multiple aspects of a complex topic.
4. **Interactive Workshops:** Students participate in a workshop-style activity, possibly involving external resources or guests.
5. **Round Robin Sessions:** Students rotate through multiple stations or groups, engaging in different activities or discussions at each.

10 Minute Strategies:

Think-Pair-Share

1. **Pose a Question:** Present a thought-provoking question related to the lesson's content.
2. **Think (1 minute):** Give students 1 minute of silence to think about their response to the question.
3. **Pair (1 minute):** Have students turn to a partner and discuss their thoughts for another minute. Again, use a timer to ensure timing is consistent.
4. **Share:** Invite pairs to share their discussions with the class. Use a predetermined signal, like a chime or visual cue, to transition from Pair to Share. Not all students have to share.

Pro-tip: Clearly explain each step before starting and remind students of the importance of respecting each phase's time limit to ensure active participation. Use a timer that students can see.

One-Minute Paper

1. **Prompt:** At the end of a lesson, ask students to write a quick response to a specific question related to the day's material or a summary of what they learned.
2. **Write (1 minute):** Give students 1 minute to jot down their thoughts.
3. **Discuss:** Choose a few responses to discuss as a class, highlighting different perspectives or clarifying misunderstandings.

Pro-tip: Encourage students to be concise in their writing, focusing on the most significant takeaway or question they have. Use a timer that students can see.

Two Truths and a Lie

1. Ask students to come up with two true statements and one false statement related to the course material covered in recent lessons.
2. Students then share their statements with a partner or small group, who must identify which statement is the lie. This encourages students to critically evaluate information and apply their knowledge creatively.
3. After the activity, briefly discuss some of the truths and lies shared, clarifying any misconceptions.

Pro-tip: Encourage creativity in the lies to challenge peers' understanding, making the activity both a learning tool and an engaging way to review content. This strategy not only reinforces students' grasp of the material but also introduces a fun, interactive element to the learning environment.

Polling

1. **Set Up:** Prepare a question or a set of questions related to your lesson in a polling tool like Poll Everywhere.

2. **Conduct the Poll:** Share the poll with your students and give them a brief moment to submit their responses.
3. **Review Results:** Once all responses are in, display the results to the class and discuss the outcomes, highlighting any interesting findings or misconceptions.

Pro-tip: Use real-time polling to gauge understanding instantly and adjust your teaching on the fly.

Correct the Error

1. **Prepare Materials:** Create materials (statements, calculations, scenarios) that contain deliberate errors related to the lesson's content.
2. **Present the Error:** Show the errors to the students, one at a time.
3. **Identify and Correct (5-10 minutes):** Ask students to work individually or in small groups to identify and correct the errors. Encourage them to explain why it's an error and provide the correct solution or reasoning.
4. **Review:** Go over each error as a class, discussing the correct solutions and the reasoning behind them.

Pro-tip: Choose common misconceptions or frequent mistakes to make this activity particularly impactful for reinforcing learning. Use a timer that students can see.

20 Minute Strategies:

Jigsaw Discussion

1. **Assign topics for students to review before class:** This could be articles to read, videos to watch, or some other material to review.
2. **Divide into Expert Groups (5 minutes):** Split the class into 'expert groups,' with each group assigned a different aspect of the topic to study.
3. **Study and Prepare (5 minutes):** Each group studies their assigned material, preparing to teach it to others. Provide resources or texts as needed.
4. **Form Jigsaw Groups (1 minute):** Reorganize the class so that each new group has one member from each of the expert groups.
5. **Teach and Discuss (8 minutes):** In their new groups, each 'expert' teaches their aspect of the topic. Group members discuss and connect the pieces of information.
6. **Wrap-Up (1 minute):** Conclude with a brief summary or a reflective question to the whole class to consolidate learning.

Pro-tip: Monitor the groups to ensure everyone participates and understands the material. Use a timer that students can see.

Case Study Analysis

1. **Introduce the Case Study (2 minutes):** Briefly present the case study, outlining the context and the issues to be analyzed.

2. **Individual Analysis (5 minutes):** Give students time to read through the case study and answer guided questions on their own.
3. **Small Group Discussion (8 minutes):** Students form small groups to discuss their analyses and answers to the guided questions, comparing insights and perspectives.
4. **Class Discussion (4 minutes):** Each group shares a key insight or conclusion with the class, fostering a broader understanding of the case study.
5. **Conclusion (1 minute):** Summarize the main learning points and real-world applications of the case study.

Pro-tip: Choose case studies that are relevant and challenging to spark engaging discussions. Use a timer that students can see.

Peer Teaching

1. **Preparation (Prior):** Assign students or groups a specific concept to research and prepare a short presentation on.
2. **Presentations (15 minutes):** Each student or group gets 3-5 minutes to present their concept to the class, depending on class size.
3. **Q&A (4 minutes):** After each presentation, allow 1-2 minutes for questions and clarifications from the class.
4. **Wrap-Up (1 minute):** Highlight the key takeaways from each presentation, emphasizing the value of peer learning.

Pro-tip: Encourage creativity in presentations to keep the class engaged. Use a timer that students can see.

Solution Swap

1. **Assign the Problem (2 minutes):** Briefly introduce a problem or case study relevant to the course material for individual or small group work.
2. **Initial Solution Phase (8 minutes):** Students work on their solutions, focusing on creating detailed and thoughtful responses.
3. **Solution Swap (1 minute):** Have students or groups exchange their solutions with another student or group.
4. **Review and Enhance (6 minutes):** Participants review the received solution, adding insights or alternative approaches to enrich the original work.
5. **Reflect and Discuss (3 minutes):** Solutions are returned to their original creators for review of the enhancements. Conclude with a quick class discussion to share insights or novel solutions discovered through the process.

Pro-tip: Encourage students to approach the review with a constructive mindset, focusing on adding value rather than critiquing. This strategy promotes critical thinking, collaboration, and the ability to consider and integrate diverse perspectives into problem-solving. Also, use a timer.

Gallery Walk

1. **Setup (3 minutes):** Before class, set up stations or posters around the room, each representing a different concept, case study, or aspect of the topic.
2. **Walk and Discuss (12 minutes):** Students circulate around the room in small groups, spending a few minutes at each station to discuss and take notes.
3. **Group Reflection (4 minutes):** After the walk, reconvene the class and have groups share their observations and insights from different stations.
4. **Wrap-Up (1 minute):** Conclude with a summary of the learning objectives and how the gallery walk helped achieve them.

Pro-tip: Encourage students to look for connections between the stations to synthesize information effectively. Use a timer that students can see.

30 Minute Strategies:

Buzz Groups

1. **Introduce the Problem (2 minutes):** Present a complex problem or question related to the course material.
2. **Form Buzz Groups (3 minutes):** Divide the class into small groups (3-4 students each) to discuss the problem and brainstorm solutions.
3. **Group Discussion (15 minutes):** Each group works on the problem, discussing various viewpoints and potential solutions. Encourage them to note down their main points.
4. **Present Solutions (8 minutes):** Groups take turns presenting their proposed solutions to the class, explaining their reasoning and methodology.
5. **Class Reflection (2 minutes):** Conclude with a brief discussion on the presented solutions, highlighting diverse approaches and the value of collaborative problem-solving.

Pro-tip: Ensure the problem is sufficiently challenging to stimulate discussion but not so difficult that it becomes frustrating. Use a timer that students can see.

Fishbowl Discussion

1. **Setup (2 minutes):** Arrange chairs in two concentric circles (an inner circle and an outer circle). The inner circle is for discussing, and the outer circle is for observing.
2. **Introduction (3 minutes):** Explain the topic of discussion and the fishbowl method, where the inner circle discusses while the outer circle listens and observes.
3. **First Discussion Round (10 minutes):** Select students to fill the inner circle and start the discussion. The outer circle silently observes without participating.
4. **Switch Roles (2 minutes):** After the first round, allow students from the outer circle to swap places with those in the inner circle.
5. **Second Discussion Round (10 minutes):** The new inner circle discusses, possibly continuing the conversation or introducing new perspectives.

6. **Wrap-Up (3 minutes):** Conclude with a whole-class reflection on the discussion, highlighting key points and insights gained from both perspectives.

Pro-tip: Encourage active listening and note-taking by the outer circle to prepare them for their turn in the discussion. Use a timer that students can see.

Concept Mapping

1. **Introduction (2 minutes):** Introduce the concept of concept mapping and its purpose in visualizing relationships between ideas or concepts. Note: The first time you introduce concept mapping will take longer.
2. **Choose a Central Concept (3 minutes):** Present a central concept or topic related to the course material.
3. **Individual or Group Mapping (15 minutes):** Students work individually or in small groups to create their concept maps, drawing connections between the central concept and related ideas, facts, or questions.
4. **Share and Discuss (8 minutes):** Have students or groups share their concept maps with the class or other groups, explaining the rationale behind their connections.
5. **Class Reflection (2 minutes):** Discuss the variety of maps produced, emphasizing the diverse ways of understanding and connecting concepts.

Pro-tip: Provide examples of concept maps to guide students unfamiliar with the technique. Use a timer that students can see.

Debate

1. **Topic Introduction (2 minutes):** Introduce the debate topic, ensuring it's relevant and has clear pro and con positions.
2. **Form Teams (3 minutes):** Divide the class into teams for and against the topic.
3. **Preparation (10 minutes):** Each team prepares their arguments, evidence, and rebuttals.
4. **Debate (12 minutes):** Teams present their arguments in a structured format, alternating between pro and con, with time for rebuttals.
5. **Class Vote and Discussion (3 minutes):** Conclude with a class vote on the most persuasive side (optional) and a discussion on the arguments presented and the importance of evidence-based reasoning.

Pro-tip: Assign roles within teams (e.g., lead speaker, researcher) to ensure active participation. Use a timer that students can see. Use a timer that students can see.

Structured Problem Solving

1. **Introduction (5 minutes):** Introduce a complex, real-world problem relevant to the course material, providing necessary background information or data. Divide the class into small groups.
2. **Understanding the Problem (5 minutes):** Groups discuss the problem to ensure a comprehensive understanding, identifying knowns, unknowns, and assumptions.

3. **Ideation and Strategy Development (10 minutes):** Groups brainstorm potential solutions, then select and develop a coherent strategy, outlining steps for implementation.
4. **Presentation and Peer Review (8 minutes):** Groups present their solutions to the class, followed by a period for questions and feedback from peers and the instructor.
5. **Wrap-Up and Reflection (2 minutes):** Discuss the variety of solutions proposed, emphasizing the application of course concepts and the value of diverse perspectives in problem-solving.

Pro-tip: Select a problem that balances challenge with achievability, ensuring it is directly related to course content to reinforce learning objectives. Encourage groups to consider multiple perspectives and to build on each other's ideas for a more comprehensive solution.

40 Minute Strategies:

Quickish PBL

1. **Introduction (5 minutes):** Introduce the mini-project or project component, outlining objectives, expectations, and deliverables. Divide the class into small groups based on project topics or components.
2. **Planning and Research (10 minutes):** Groups spend time planning their approach and conducting initial research. Provide guidance on resources and tools they can use.
3. **Project Work (20 minutes):** Groups work on their projects, applying what they've learned to create, build, or analyze their assigned components. Circulate to offer support and answer questions.
4. **Initial Presentations (5 minutes):** Each group shares a brief update on their progress, challenges, and next steps. This fosters accountability and allows for peer feedback.

Pro-tip: Please look for the more in-depth version of Project Based Learning following this section. (It's in its own section.) Encourage groups to assign roles to ensure that all members are actively participating and contributing.

Student-Led Seminars

1. **Preparation (Prior):** Assign seminar topics and dates in advance. Provide students leading the seminar with guidelines on how to prepare and structure their session.
2. **Introduction (5 minutes):** The student leaders introduce the topic, outlining key questions and objectives for the seminar.
3. **Presentation and Discussion (25 minutes):** The student leaders present key concepts, followed by facilitated class discussion. They should employ various techniques to engage their peers, such as open-ended questions, small group discussions, or interactive activities.
4. **Wrap-Up (5 minutes):** Conclude with a summary of the main points discussed, highlighting any unresolved questions or areas for further exploration.
5. **Feedback (5 minutes):** Provide immediate constructive feedback to the student leaders on their facilitation, and encourage peer feedback as well.

Pro-tip: Encourage student leaders to use multimedia resources to enrich the seminar content.

Case Study Exploration

1. **Introduction (5 minutes):** Present the case study, explaining its relevance and the specific aspects to focus on during the analysis.
2. **Individual Reading (10 minutes):** Allow students time to read through the case study independently, noting key points, questions, and potential solutions.
3. **Group Analysis (15 minutes):** Students form small groups to discuss their findings and analyses, working together to answer guided questions or solve problems presented in the case study.
4. **Class Discussion (10 minutes):** Groups share their insights and proposed solutions with the class, facilitating a broader discussion that synthesizes the collective understanding and perspectives on the case.

Pro-tip: Please look for the more in-depth version of Case Studies following this section. (It's in its own section.) Select case studies that are complex and multifaceted to encourage deep analysis and discussion.

Socratic Seminar

1. **Preparation (Prior):** Assign a text or a set of questions for students to prepare in advance. Provide guidelines on Socratic questioning techniques.
2. **Question Introduction (5 minutes):** The student facilitator introduces the main questions or themes to guide the discussion.
3. **Seminar Discussion (30 minutes):** The discussion unfolds as a student-facilitated dialogue, with participants asking and answering questions in a manner that probes deeper into the subject matter. The teacher acts as a guide to keep the discussion focused and inclusive.
4. **Reflection (5 minutes):** Conclude with a reflection on the discussion, highlighting key insights gained and areas for further inquiry.

Pro-tip: Encourage students to listen actively and build on each other's ideas, fostering a collaborative learning environment.

Design Challenge

1. **Challenge Introduction (5 minutes):** Present a real-world problem and outline the challenge, including any specific constraints (e.g., budget, materials, time).
2. **Brainstorming (10 minutes):** Groups brainstorm potential solutions, considering the constraints and desired outcomes. Encourage creativity and out-of-the-box thinking.
3. **Design and Planning (15 minutes):** Groups select their best idea and plan their design solution, sketching out concepts or creating a project plan.
4. **Presentations (10 minutes):** Each group presents their proposed solution to the class, explaining their design process and how their solution addresses the challenge.

Pro-tip: Facilitate a feedback session after presentations, where students can offer constructive critiques and suggestions for improvement.

50 Minute Strategies:

In-Depth Lab Experiments

1. **Pre-Lab Briefing (5 minutes):** Introduce the experiment's objectives, hypothesis, and procedures. Ensure students understand the safety protocols.
2. **Experimentation (30 minutes):** Students conduct the experiment in small groups, following the step-by-step procedures. Encourage them to take detailed notes on their observations and results.
3. **Data Analysis (10 minutes):** Groups analyze their data, comparing results with the hypothesis and discussing any discrepancies or unexpected findings.
4. **Group Discussion (5 minutes):** Conclude with a class discussion on the experiment's outcomes, key learnings, and real-world applications of the concepts explored.

Pro-tip: Encourage students to ask questions and explore the "why" behind each step to deepen their understanding.

Extended Project Work

1. **Project Check-In (10 minutes):** Begin with a brief update from each group on their project's status, highlighting achievements and challenges.
2. **Work Session (30 minutes):** Groups work on their projects, focusing on predetermined milestones or addressing challenges identified during the check-in.
3. **Peer Feedback (5 minutes):** Groups briefly present their progress to another group for constructive feedback and suggestions.
4. **Class Discussion (5 minutes):** Share broader insights or common challenges faced by groups, discussing potential solutions or strategies to overcome them.

Pro-tip: Set clear objectives for each work session to ensure productive use of time and progress towards project completion.

Full-Class Debate

1. **Topic Introduction (5 minutes):** Introduce the debate topic, ensuring it's complex enough to allow for multiple viewpoints.
2. **Team Formation and Preparation (10 minutes):** Divide the class into teams, assigning different perspectives or positions on the topic. Allow time for brief preparation and argument formulation.
3. **Debate (30 minutes):** Conduct the debate, allowing each team time to present their arguments, followed by rebuttals and cross-examinations. Ensure a balanced participation and adherence to debate rules.
4. **Reflection and Discussion (5 minutes):** Debrief the debate, discussing the strengths of various arguments, the importance of evidence, and the value of understanding multiple perspectives on complex issues.

Pro-tip: Use a neutral moderator to keep the debate focused and fair, ensuring all voices are heard.

Interactive Workshops

1. **Workshop Overview (5 minutes):** Introduce the workshop's theme and objectives, outlining the activities planned.
2. **Activity Sessions (35 minutes):** Break the workshop into smaller, interactive sessions or activities. These could involve hands-on tasks, discussions, or problem-solving exercises, potentially facilitated by guest speakers or using external resources.
3. **Group Sharing (5 minutes):** Allow groups or individuals to share insights or outcomes from the activities with the rest of the class.
4. **Wrap-Up (5 minutes):** Conclude with a summary of key learnings from the workshop and how they apply to the course content or real-world scenarios.

Pro-tip: Incorporate diverse activities that cater to different learning styles to maximize engagement and learning outcomes.

Round Robin Sessions

1. **Session Setup (5 minutes):** Briefly explain the round robin format and the activities or discussion topics at each station.
2. **Rotation (35 minutes):** Students rotate through the stations in small groups, spending a set amount of time (e.g., 7 minutes) at each. Ensure smooth transitions between stations.
3. **Group Reflection (5 minutes):** After completing all stations, reconvene as a class. Groups share their takeaways or interesting findings from each station.
4. **Class Discussion (5 minutes):** Discuss how the activities enhanced their understanding of the course material, addressing any questions that arose during the sessions.

Pro-tip: Clearly define the objective of each station and provide necessary materials or instructions to ensure students can engage immediately upon rotation.

Problem-Based Learning (PBL):

Real-world problems can be used as a basis to teach students how to apply theoretical concepts and develop problem-solving skills. It helps stimulate an entrepreneurial mindset by encouraging students to seek out innovative and creative solutions.

Assigning projects that require students to work in teams and create a tangible product or solution can help them understand the practical applications of theoretical knowledge. This encourages collaboration, one of the key aspects of the entrepreneurial mindset.

STEP 1:

Identify the Learning Outcomes: Start by identifying the learning outcomes that you want students to achieve. These can range from understanding specific theoretical concepts to developing problem-solving skills, teamwork, critical thinking, or creativity. Basically, what are your objectives. Always start with your objectives.

STEP 2:

Choose a Real-World Problem: Choose a real-world problem that aligns with your learning outcomes and course content. The problem should be open-ended, meaning there is no single correct answer. This encourages students to explore different solutions and promotes creativity and critical thinking.

Examples:

Sustainable Energy: Students might be tasked with designing an efficient and low-cost renewable energy system for a small, off-grid community. This problem could involve concepts from mechanical, electrical, and environmental engineering.

Natural Disaster Response: Task students with creating a reliable communication system that can operate in disaster-hit areas to coordinate relief efforts. This problem brings together knowledge from electrical engineering, computer science, and civil engineering.

Waste Management: Design a comprehensive waste management system for a large metropolitan city that includes waste collection, transportation, processing, recycling, and disposal. This can be a practical problem for civil, environmental, and mechanical engineering students.

Accessible Healthcare Technology: Design a low-cost, portable, and user-friendly medical device that can be used in remote areas or by the elderly at home for routine health check-ups. This problem could involve biomedical engineering, electrical engineering, and computer science.

STEP 3:

Create the PBL Assignment Brief: Prepare a brief that describes the problem and the assignment's requirements. This should include the problem's background, the assignment's objectives, the expected deliverables (e.g., a written report, a presentation, a prototype), and the deadline.

Sample PBL Assignment Brief:

Course: Engineering Design 101

Assignment: Problem-Based Learning Group Project

Objective: To apply engineering concepts learned in class to solve a real-world problem, fostering your problem-solving skills, creativity, teamwork, and communication skills.

Problem Statement: Your team is tasked with designing a low-cost, efficient, and user-friendly water purification system for a small, off-grid community in a developing country. The system should use locally available resources as much as possible and should be easy to maintain by the local community. Consider the local climate and geographical features in your design.

Group Size: 4-5 students

Deliverables:

1. A project report detailing:
 - An understanding of the problem and the community's needs.
 - The proposed design of the water purification system, including its components and how it works.
 - The reasoning behind your design decisions and how you have applied engineering concepts learned in class.
 - The expected performance of your system and how it meets the community's needs.
 - Any challenges you foresee in implementing your system and suggestions on how these can be overcome.
2. A 15-minute group presentation outlining your project. This should include a clear explanation of your proposed solution, the engineering concepts used, and a discussion of its feasibility.

Timeline:

- Week 1-2: Understand the problem and conduct research
- Week 3-4: Brainstorm and develop the initial design
- Week 5-6: Refine the design and start working on the project report
- Week 7: Finalize the project report and prepare for the presentation
- Week 8: presentation and submission of the project report

Assessment: You will be graded on your understanding of the problem, the application of engineering concepts, problem-solving skills, creativity, teamwork, communication, and reflection on learning. Please refer to the rubric provided for detailed grading criteria.

Resources: Useful resources for this project include the course textbook, online resources on water purification technologies, and consultation sessions with the instructor. Remember, this is a learning journey. The primary goal is not to design a perfect system, but to apply what you've learned, think critically and creatively, and learn from the process.

Group Formation: Divide students into small groups. Collaborative learning is a crucial part of PBL and helps students develop teamwork and communication skills.

Guidance and Support: Provide guidance and support as students work on the problem. This can involve regular check-ins to monitor progress, providing resources or scaffolding to help students understand the problem better, and giving feedback to guide students.

Reflection and Assessment: After the assignment is completed, encourage students to reflect on what they have learned and how they can apply this in the future. Assessment should be based on both the final product and the learning process.

Sample Project Based Learning Rubric:

Criteria	Excellent (90-100%)	Good (70-89%)	Satisfactory (50-69%)	Unsatisfactory (<50%)
Understanding of the Problem	Demonstrates a thorough understanding of the problem and its complexities	Understands the problem well but may miss minor aspects	Shows basic understanding of the problem but misses significant aspects	Demonstrates a lack of understanding of the problem
Application of Knowledge	Applies relevant theoretical concepts effectively and accurately	Applies most theoretical concepts correctly, with minor errors	Applies some relevant theoretical concepts but has notable errors	Fails to apply relevant theoretical concepts correctly
Problem-Solving Skills	Develops and applies effective problem-solving strategies	Uses good problem-solving strategies with minor flaws	Uses some problem-solving strategies but with significant flaws	Fails to use effective problem-solving strategies
Creativity and Innovation	Provides highly creative and innovative solutions	Offers creative and somewhat innovative solutions	Solution shows some creativity but lacks innovation	Solution lacks both creativity and innovation
Teamwork and Communication	Excels in team collaboration and communication of ideas	Communicates effectively, and generally works well within the team	Some issues in team collaboration and communication	Poor teamwork and difficulty in communicating ideas
Reflection and Learning	Reflects deeply on learning and future application	Shows good reflection and understanding of future application	Some reflection but lacks depth in understanding future application	Little to no reflection on learning and future application

Case Studies:

A Case Study Assignment involves an in-depth analysis of a particular event, situation, individual, or group over a specific period. Case studies provide students with a comprehensive scenario to investigate, allowing them to apply theoretical knowledge to real-world contexts. The case itself can be drawn from real-life events or can be fictional, crafted to elicit critical thinking and problem-solving.

Case Study Framework:

1. **Case Selection:** Choose a real-world case that aligns with the learning objectives of your course. The case could be a historical event, a contemporary issue, a business situation, a scientific problem, etc., depending on the discipline.
2. **Preparation:** Prepare a detailed case brief that presents the situation, background information, challenges, outcomes, and other pertinent details. It could be helpful to frame the case within a larger context or introduce specific concepts that students should use to analyze the case.
3. **Assignment:** Provide students with the case brief and a set of guiding questions that will focus their analysis. These questions should be open-ended, requiring critical thinking and application of course material.
4. **In-Class Discussion:** Allocate time for students to discuss the case in groups and share their findings with the entire class. Facilitate the discussion by asking probing questions, challenging assumptions, and directing the conversation toward the learning objectives.
5. **Reflection & Evaluation:** Following the discussion, ask students to write a reflection or a formal case analysis paper. This serves as an opportunity for students to synthesize their thoughts, articulate their ideas in writing, and demonstrate their understanding.

Example Case Study Assignment:

Course: Environmental Science 301

Topic: Climate Change Mitigation Strategies

Case Study: "Renewable Energy Transition in Country X: Opportunities and Challenges"

Assignment Brief:

1. **Reading:** Read the provided case study on the transition to renewable energy in Country X. As you read, consider the following questions:
 - What were the key strategies used by Country X to promote renewable energy?
 - What were the major challenges faced during this transition?
 - How were these challenges addressed, and how effective were these measures?
 - How does this case illustrate the broader issues and concepts we've studied in class about climate change mitigation?

In-Class Activities:

1. **Group Discussion:** You will be divided into small groups to discuss your answers to the questions above. Each group will then present their main findings to the class.
2. **Class-Wide Discussion:** As a class, we will explore the broader implications of the case, relating it to other examples we've studied and the overarching themes of the course.

Post-Class Assignment:

1. **Case Analysis Paper:** Write a 3-5 page paper analyzing the case study in depth. Your paper should address the questions provided, integrate course concepts, and demonstrate critical thinking.

Example case study rubric:

Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Needs Improvement (D/F)
Understanding of the Case	Demonstrates comprehensive understanding of the case's complexities and underlying issues.	Shows clear understanding of the case's main points and context.	Shows understanding of the case but may have minor inaccuracies.	Lacks understanding of the case or has significant inaccuracies.
Analysis	Conducts thorough, insightful analysis using relevant theories/concepts. Identifies all relevant problems/issues.	Conducts good analysis using relevant theories/concepts. Identifies most relevant problems/issues.	Conducts basic analysis, but may overlook some issues or not fully apply theories/concepts.	Minimal or flawed analysis. Overlooks key issues and/or does not apply relevant theories/concepts.
Recommendations	Provides clear, feasible, and innovative recommendations backed by solid reasoning and evidence.	Provides clear and feasible recommendations backed by reasoning and evidence.	Provides recommendations, but may lack clarity, feasibility, or sufficient support.	Provides vague, unfeasible, or unsupported recommendations.
Communication and Writing	Writing is clear, organized, and free from errors. Communicates ideas effectively.	Writing is mostly clear and organized with minimal errors. Communicates ideas well.	Writing is somewhat clear and organized. May have some errors or communication issues.	Writing lacks clarity and organization. Contains numerous errors.
Use of Evidence and Citation	Uses ample evidence from the case and external sources to support analysis. Citations are accurate and in correct format.	Uses sufficient evidence from the case and may use some external sources. Most citations are accurate and in correct format.	Uses some evidence from the case but lacks sufficient support. Some citation errors or inconsistencies.	Uses minimal evidence and/or does not properly cite sources.

Reflection Journals

A reflection journal, often also referred to as a reflective diary, is a personal record where individuals document their reactions, insights, thoughts, and feelings about experiences, events, readings, or ideas. Unlike traditional diaries or journals, which might chronologically detail events or thoughts, reflection journals emphasize a deeper contemplation about experiences, leading to personal growth and learning.

Components of a Reflection Journal:

1. **Date and Time:** Just like any journal or diary, noting down the date and time can help in tracking the progression of thoughts over a period.
2. **Description of the Event/Experience:** Before diving into reflections, briefly describe what happened. This sets the context for the reflection.
3. **Emotional Response:** Detail your immediate emotional reaction. Were you happy, sad, frustrated, excited, etc.?
4. **Analytical Reflection:** Dive deeper into why you felt the way you did. Try to identify triggers for those emotions and any patterns in your reactions.
5. **Insights Gained:** Discuss any epiphanies, realizations, or lessons you derived from the experience.
6. **Connections:** Relate the current reflection to past entries or past experiences. Do you see any patterns or trends?
7. **Actionable Steps:** Based on your reflections, jot down what you'd like to continue doing, what you'd change, and any steps you'd take in the future when faced with a similar situation.
8. **Questions:** Sometimes, reflecting can lead to more questions than answers. It's beneficial to note these down for future contemplation or research.

Tips for using the following rubric with reflection journals:

1. **Introduce Early:** Before students begin their reflection journals, introduce them to this rubric. This sets clear expectations and gives them a guide to aim for higher-quality reflections.
2. **Encourage Honesty:** Remind students that the purpose of reflection journals is personal growth. While the rubric sets quality standards, it's important to remain genuine and honest in reflections.
3. **Feedback:** Use the rubric not just for grading (if you're grading the journals) but also for feedback. Highlight areas where the student showed deep reflection and areas they could explore further.
4. **Iterative Improvement:** If the journals are maintained over a longer period of time, encourage students to look back at past reflections and see their growth and changes in perspective.
5. **Personalization:** Remember, reflection journals are personal. While the rubric provides an assessment framework, it's essential to consider each student's unique perspective and journey.

Sample Reflection Journal Rubric

Criteria	5 - Excellent	4 - Good	3 - Satisfactory	2 - Needs Improvement	1 - Unsatisfactory
Depth of Reflection	Demonstrates deep introspection. Considers multiple perspectives.	Shows good insight. Some varied perspectives.	Basic reflection without much depth.	Superficial reflection. Misses deeper issues.	Merely describes events without reflection.
Understanding of Concepts	Clearly connects learning to concepts. Articulates understanding effectively.	Connects most learning to concepts. Few gaps in understanding.	Some connection to concepts. Some misunderstandings.	Rarely connects learning to concepts. Many gaps.	Shows no understanding or connection to concepts.
Connections to Past Learnings	Consistently links current learning to past experiences and knowledge.	Often links to past learnings, with minor gaps.	Occasionally links current to past learnings.	Struggles to connect current learning to past experiences.	Doesn't connect or relate learnings at all.
Application to Real-World/Future	Foresees future applications. Relates to real-world implications.	Sees some future applications. Some real-world connections.	Limited foresight on application. Few real-world mentions.	Rarely considers future applications or real-world relevance.	Doesn't consider or mention real-world application.
Clarity & Organization	Journal entries are clear, coherent, and well-organized.	Entries are mostly clear and organized, with minor issues.	Entries show some organization. Occasional clarity issues.	Entries often lack clarity and organization.	Entries are disorganized, disjointed, or incoherent.

Peer Feedback Assignment

A Peer Feedback Assignment involves students assessing and providing feedback on the work of their peers. This process helps students understand criteria for quality work, encourages active engagement with content, and fosters a collaborative learning environment. By critically evaluating the work of peers, students often gain deeper insights into their own strengths and areas for improvement.

Sample Rubric for Peer Feedback

Criteria	5 - Excellent	4 - Good	3 - Satisfactory	2 - Needs Improvement	1 - Unsatisfactory
Constructiveness	Feedback is consistently positive, helpful, and aimed at improvement.	Feedback is mostly constructive with minor gaps.	Feedback is neutral, neither harmful nor particularly helpful.	Feedback is occasionally negative or not useful.	Feedback is negative without offering solutions.
Relevance & Accuracy	All feedback is relevant to the work and accurate.	Most feedback is relevant and accurate. Minor discrepancies.	Around half of the feedback is relevant and accurate.	Most feedback is either irrelevant or not accurate.	Feedback lacks relevance and accuracy entirely.
Clarity & Specificity	Feedback is clear, specific, and easy to understand.	Feedback is clear for the most part with occasional vagueness.	Some feedback points are clear, others are vague.	Feedback is often vague or generic.	Feedback is unclear, too broad, or confusing.
Respectfulness	Feedback is always respectful, considerate, and professional.	Feedback is mostly respectful with minor lapses.	Feedback is neutral, neither particularly respectful nor disrespectful.	Feedback occasionally contains disrespectful tones.	Feedback is consistently disrespectful.
Recommendations for Improvement	Offers detailed, actionable suggestions for improvement.	Offers some good suggestions with occasional gaps.	Provides generic or broad suggestions.	Rarely offers useful suggestions.	Doesn't provide any recommendations.

Tips for using this rubric for Peer Feedback:

1. **Set Expectations:** Before the peer feedback process begins, discuss the importance of constructive, respectful feedback with students. The aim should be mutual growth and learning.
2. **Training Session:** Consider a brief training or discussion on how to give effective feedback. This helps students understand the difference between constructive criticism and mere negative feedback.
3. **Anonymity:** Depending on the nature of the assignment or the class dynamic, consider allowing anonymous feedback. This might encourage more honesty, but it should still be constructive.
4. **Feedback on Feedback:** After the peer review process, give students a chance to reflect on the feedback they received. Was it helpful? Why or why not? This meta-feedback process can improve the quality of future peer reviews.
5. **Revision:** If applicable, allow students to revise their work based on the peer feedback they've received. This turns feedback into a tangible learning opportunity.

Direct Observation of Active Student Learning refers to a method where educators or evaluators directly observe and assess students as they engage in learning activities. This hands-on approach allows for immediate insights into a student's learning processes, behaviors, skills, and abilities.

Sample Direct Observation of Student Learning Rubric

Criteria	5 - Excellent	4 - Good	3 - Satisfactory	2 - Needs Improvement	1 - Unsatisfactory
Engagement	Fully engaged throughout. Takes initiative in tasks.	Mostly engaged. Participates actively.	Engages when prompted.	Infrequent engagement. Often off-task.	Rarely or never engaged. Totally off-task.
Collaboration	Excellent team player. Facilitates group discussions.	Collaborates effectively. Respects peers.	Collaborates, but occasionally dominates.	Struggles to collaborate. Sometimes dismissive.	Doesn't collaborate. Often dismissive or isolated.
Communication	Articulates ideas clearly. Encourages peer communication.	Communicates well. Occasionally needs clarification.	Adequate. Some clarity issues.	Often unclear or too brief.	Rarely communicates or does so inappropriately.
Problem-solving	Consistently offers innovative solutions.	Often suggests relevant solutions.	Provides solutions when prompted.	Struggles to provide solutions.	Doesn't contribute to problem-solving.
Responsiveness	Always attentive to group dynamics and adjusts.	Mostly attentive and adjusts when needed.	Sometimes misses cues but can adjust.	Often misses social/group cues.	Unresponsive to group dynamics or feedback.

When using this rubric for direct observation:

1. **Ensure Familiarity:** Make sure students are familiar with the criteria before the activity. This transparency ensures they know what's expected of them.
2. **Observe Objectively:** As an observer, strive to be as unbiased and objective as possible. It's about assessing based on the displayed behaviors, not personal feelings towards a student.
3. **Provide Feedback:** After observation, use the rubric as a guide for feedback. Let students know where they excelled and where they can improve.
4. **Encourage Self-Assessment:** Allow students to assess themselves using the rubric. It can be an enlightening exercise in self-awareness and reflection.

Startup Simulation Game:

Objective: The goal of this simulation game is to allow students to experience the process of founding a startup from conception of an idea to market launch, including the challenges that come with it.

Setup:

1. Divide students into groups of 3-5. Each group represents a startup company in the engineering sector.
2. Each startup is given a starting budget (in virtual currency).
3. Provide a list of different categories that companies might need to invest in, such as product development, market research, marketing, personnel, and manufacturing.

Gameplay:

1. **Idea Generation:** Each team must brainstorm and develop a business idea for a new engineering product or service. They should consider what problem their product solves and who their target market would be.
2. **Budget Allocation:** Teams will then allocate their starting budget across the different investment categories. They must justify their decisions based on their business plan.
3. **Pitch:** Each team will create a short pitch for their startup idea, which they will present to the class (acting as potential investors). They should explain their business idea, target market, and how they've allocated their budget.
4. **Feedback & Revision:** After all pitches are given, have a class discussion about each pitch. Then, each team will have a chance to revise their business plan and budget allocation based on the feedback received.
5. **Simulation Rounds:** Over several rounds, present teams with various scenarios that simulate real-world challenges a startup might face (e.g., product development delays, changes in market trends, unexpected costs). Teams will need to adjust their plans and budgets accordingly.
6. **Final Presentation:** At the end of the simulation, teams will present their final business plan, including what challenges they faced and how they adapted.

Debrief: After the simulation, have a debriefing session where students reflect on their experiences. Discuss what they learned about entrepreneurship, how they dealt with the challenges, and how their engineering skills were applicable in this context.

Reflection Activities

Encourage faculty to reflect on their learning, draw connections between different ideas, and think about how they can apply their new knowledge in their teaching. This can promote a deeper understanding of the entrepreneurial mindset.

Learning Map Reflection Activity:

Objective: The goal of this activity is to allow faculty to reflect on what they have learned during the workshop, how they can implement it in their teaching, and what challenges they might face.

Instructions:

1. **What I Learned:** Faculty participants start by creating a mind map or list of the key active learning techniques and ideas they learned during the workshop. They should jot down everything they found valuable, interesting, or challenging.
2. **Application in My Teaching:** Next, faculty should reflect on how they can incorporate these techniques into their teaching. They should think about their specific courses, student population, and teaching style. They could sketch out a rough plan or a few ideas for lessons or activities that incorporate the active learning techniques.
3. **Anticipated Challenges:** Finally, faculty should identify potential challenges or obstacles they might face in implementing these techniques, and brainstorm possible solutions or strategies to overcome them.
4. **Sharing and Discussion:** After completing their Learning Maps, faculty could be encouraged to share their reflections in small groups or with the whole group. This can spark further insights, provide new ideas for overcoming challenges, and create a sense of shared understanding and purpose among the faculty.

Debrief: To close the activity, bring the whole group back together for a final discussion. Highlight common themes or interesting ideas that came up during the sharing. Discuss next steps for implementing active learning techniques and how the faculty can support each other in this process.