Jigzaw Puzzle

The **Jigsaw Puzzle Method** is a **collaborative** method in which a topic is divided into subtopics. Students first learn one subtopic in **expert groups**, then return to **home groups** (with one expert per subtopic) to teach it to their peers. It can be performed in one or more sessions.

Complexity : ☕☕☕

Group size: medium

Format: online, on-site, (hybrid)

Learning objectives / benefits

- Develop a deep understanding of subtopics
- Encourage active engagement instead of passive listening.
- Strengthen communication, cooperation, and teamwork.

Implementation

- **Divide the topic**: Break the topic into 3–6 distinct subtopics (“puzzle pieces”), each suitable for a small group.
- **Form the home groups**: Create groups of 3–6 students and assign each student one subtopic.
- **Form the expert groups**: students meet with others assigned the same subtopic to study, discuss, and prepare to teach their material.
- **Peer teaching in home groups:** Students return to their home groups to teach their part. The group reconstructs the full topic together.
- **Whole-Class Integration & Clarification:** answer open questions and clarify possible misconceptions. You can combine this with a quiz to test students’ gained knowledge.

Recommendations

- Provide **clear instructions, expectations, and timelines** at the beginning. This method can feel chaotic if not well-structured.
- Assign **questions or key concepts to each expert group** to support and guide their preparation. You can also provide them with useful material and resources.
- Use the method for **deepening** or for **review**, rather than incorporating new information. Students can feel unsure about their own performance, or they might not trust other students' performance, leaving them feeling they are missing information.
- **Make the learning progress visible** by asking questions at the end that they can answer with the information learned, or that help them reflect on their own progress.

Further reading

Cochon Drouet O, Lentillon-Kaestner V and Margas N (2023) Effects of the Jigsaw method on student educational outcomes: systematic review and meta-analyses. Front. Psychol. 14:1216437. doi: 10.3389/fpsyg.2023.1216437

More information: Sofía Vio, TUM

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Open Fishbowl

The **Open Fishbowl** is a dynamic discussion method in which a small group of students sits in an inner circle to discuss a topic, while one **empty chair** remains available for any observer to join at any time. When someone enters, a current participant leaves, ensuring continuous rotation and inclusive dialogue.

Complexity : 

Group size: small to large

Format: online, on-site

Learning objectives / benefits

- Engage in **critical thinking**, analyzing arguments and assumptions.
- Strengthen **ability to articulate and defend** ideas.
- Practice **constructive dialogue and perspective-taking.**

Implementation

- **Preparation**: Choose an open-ended topic or case. Students might need to prepare for the discussion.
- **Arrange the room:** create an inner circle with an empty chair and an outer circle. Alternatively, place a row of chairs in the front of the class that will work as an inner circle.
- **Introduce the rules**: explain how the method works, and address the importance of respectful communication
- **Define the roles:** assign who will start in the inner circle. You can also assign a role to the participants on the outer circle (evaluate the discussion, write down key arguments)
- **Conduct the discussion**: The teacher has a moderation role, asking guiding questions, but not participating directly.
- **Debrief:** Summarize the discussion and highlight key learning points. Here, the outer circle can share their findings.

Recommendations

- Discussion works best when the students are **interested in the topic** and have high motivation to share their opinions
- Allow **voluntary rotation** rather than forced turns for more authentic contributions.
- Use **rubrics or checklists** to help observers focus their attention.
- Students may hesitate to take the open chair—consider **warm-up** activities.
- **Discussion can drift** without careful facilitation. Having a few questions ready can help keep the conversation focused and engaging.

Further reading

Centre for Academic Teaching and Learning (2023) **Fishbowl Method** Teaching and Learning Collection.

More information: Sofía Vio, TUM

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Role-Based Simulations

Role-based simulations place students in a realistic, discipline-specific scenario where they assume roles (e.g., engineer, project manager, regulator, scientist, community stakeholder). Students must make decisions, negotiate, apply technical and professional knowledge, and manage consequences in a safe, guided learning environment.

Complexity : ☕☕☕

Group size: small-medium

Format: online, on-site

Learning objectives / benefits

- Apply domain-specific knowledge to solve complex problems.
- Strengthen communication skills.
- Safe environment for practicing high-risk or high-stakes situations.

Implementation

- **Create an authentic scenario** and define **distinct stakeholders** with goals, constraints, and information. Include details that will help the students interact during the simulation and prepare them for uncertainty.
- **Assign roles, define rules**, and outline the simulation flow. Let them prepare for the role and prepare. If you have students who are not active in the simulation, assign them a function (evaluate the interaction, write down critical moments, or alternative solutions)
- **Run the Simulation:** Students enact their roles, make decisions, negotiate, and respond to evolving conditions. The **teacher serves as moderator**, managing time and intervening if the discussion gets critical.
- **Debrief and let the students reflect** on the outcomes of the simulation, mistakes, alternative decisions and reasoning.

Recommendations

- **Start small.** Begin with simple simulations before moving to complex, multi-role scenarios.
- **Reduce unpredictability.** Provide students with guidance on likely stakeholder reactions (e.g., pain points, negotiation limits, and when to withhold information). You can also let students pre-decide how their role will respond.
- **Support emotional safety.** Realistic cases can feel intense; create a safe environment and check in with students.
- **Be ready to intervene.** Student choices can be unpredictable. Effective simulations require a moderator prepared to step in and redirect when needed.
- **Keep students motivated.** Ground scenarios in realistic cases and clear roles to sustain engagement.

Further reading

University of Illinois Urbana-Campaign (2023) **Role Play**, Engagement in Engineering Education.

More information: Sofía Vio, TUM

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

Poster Session

A **Poster Session** or Gallery Walk is a method in which students move around the room to visit multiple stations displaying student work. They analyze, discuss, write responses, and build on others' ideas as they circulate.

Complexity : ☕☕☕

Group size: small-large

Format: online, on-site (hybrid)

Learning objectives / benefits

- **Analyze information** from multiple perspectives.
- **Develop communication skills** by presenting, questioning, and giving feedback.
- Encourages **broad participation**, including quieter students.

Implementation

- **Prepare stations.** Assign students to create each station (e.g., a poster or project result) or prepare the stations yourself.
- **Organize the room.** Space stations far enough apart to prevent crowding.
- **Give clear instructions.** Explain how students should circulate and what they should do at each station—take notes, compare ideas, discuss, or answer prompts.
- **Rotate.** Students move individually or in groups, review the content, and add comments or answers.
- **Wrap up.** End with a class-wide reflection. Options include:
  - groups summarizing insights from one station
  - students sharing with a partner
  - contributing ideas to a (digital) board
  - a few students presenting to the class

Recommendations

- **Start simple.** Begin with small, low-complexity simulations before moving to multi-role scenarios.
- **Ask open-ended questions.** Focus on analysis rather than recall to deepen thinking.
- **Build on each other's ideas.** Encourage students to respond to classmates' comments to create collaborative knowledge.
- **Give meaningful roles.** Assign tasks to roaming students—discussion prompts, rubric-based feedback, or evaluation grids.
- **Prevent crowding.** Space stations well and set rotation times. Hallways can work better than classrooms because they offer more room and visibility.
- **Try online options.** Use digital boards for the posters with breakout rooms for the discussion. You can also use virtual spaces (e.g., GatherTown) to replicate stations online.

More information: Sofía Vio, TUM

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

Retrieval checkpoints

Retrieval checkpoints consist of a set of rapid, low-stakes questions designed to strengthen memory and application, sharpen understanding, and maintain engagement throughout a class session. It includes **low-stakes questions**, all aimed at helping students retrieve key concepts repeatedly in a low-pressure, motivating way.

Complexity :

Group size: small to large

Format: all formats

Learning objectives / benefits

- Strengthen **retrieval practice** and long-term retention.
- Develop students' ability to **identify misconceptions**
- Incentives students to **develop their own strategy** for solving problems or approaching the topics presented in class

Implementation

Choose key topics students need to recall often (definitions, processes, calculations, common pitfalls).
Create 2–4 low-stakes questions per 45-minute session. Mix formats as needed.
Use them during class: an online tool, raised hands, cold-calling, or paired discussion for more complex topics.
Reveal the answer immediately. Clarify misconceptions and encourage brief peer discussion.

Question types:

- Single choice
- Binary-choice
- Fill-in-the-Blank
- Short explanation
- Ranking or ordering

Examples:

A motor lifts a 20 kg object by 5 m in 4 seconds. Calculate the power output.

Which is the right formula for power?

a. $P = \frac{W}{t}$

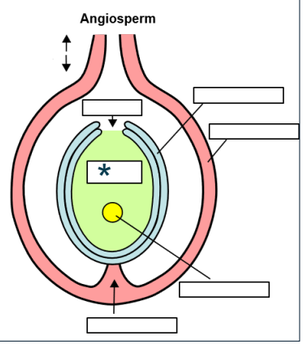
b. $P = mgh$

* Explanation: Students often confuse the **work formula instead of the power formula**

Select the right label for structure * in the diagram.

a. Nucellus

b. Integument



Recommendations

- **Keep quizzes short and frequent** to maintain momentum.
- **Use realistic distractors** based on common student misconceptions.
- **Lower anxiety when participation is low.** Allow anonymous responses in large groups.
- **Ask students to explain their reasoning**—to a classmate or the whole class.
- **Increase stakes and difficulty gradually** as students gain confidence.
- **Use this method to help students:**
  - build problem-solving strategies
  - retrieve and interpret chemical pathways
  - make decisions using established frameworks

More information: Sofía Vio, TUM

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

Quizzes

Quizzes are a **fast and easy way to engage students** during the lectures, by asking questions that they can answer immediately by choosing from a set of possible answers. It can be used to **check if the students are advancing in their learning process**. But it can also be used as a **starting point for discussions**.

Complexity : 

Group size: large

Format: all formats

Learning objectives / benefits

- **Break the passive listening cycle**
- Encourage students to **think**, **process**, and **apply** concepts
- Give teacher **feedback on the learning process**

Implementation

- **Define the purpose.** Decide whether the quiz checks knowledge, boosts motivation, ensures reading accountability, or provides practice.
- **Design short questions.** Keep the quiz brief and focused.
- **Choose the platform.** Options include your learning management system, online tools, or quick in-class methods (hands raised, standing up).
- **Provide timely feedback.** Share the correct answer and clarify misconceptions right away.

Recommendations

- **Time matters**: Quizzes and clarifying wrong answers take time—plan for it.
- **Tech delays**: Apps require login time; students may get distracted.
- **Low-tech option**: Show questions on slides and use hand-raising or standing up.
- **Student adaptation**: If students aren't used to active learning, they need time. Be consistent and patient.
- **Discussion potential**: Use open-ended questions (e.g., ethical or strategic choices) to spark debate.
- **Connect Quizzes to Learning Outcomes**: Show students how correct answers reflect what they should learn.
- **Use a pre/post quiz**: Ask a hard question at the start, repeat at the end to highlight progress.

More information: Sofía Vio, TUM

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

Cheat Sheet / Create Possible Exam Questions

Students create a one-page “cheat sheet” or formulate possible exam questions based on **key concepts from the session.** Instead of passively reviewing content, they **actively identify core ideas, structure knowledge, and anticipate assessment formats**. The method can be used during or at the end of a session and works individually or collaboratively.

Complexity : 

Group size: large

Format: all formats

Learning objectives / benefits

- **Promote deep processing** instead of surface memorization
- Encourage **identification of core concepts** and key relationships
- Strengthen **metacognitive skills** (What is important? What might be tested?)
- Make expectations transparent in international courses
- Support exam preparation continuously throughout the semester

Implementation

- **Plan placement**: Insert after key or difficult topics, or at the start/end of the session, or for a preparation
- **Choose the format**:
  - Individual cheat sheet (1 page maximum)
  - Small groups create 3–5 possible exam questions
  - Online: shared document, Padlet, breakout rooms
  - Hybrid: digital submission for transparency
- **During the lecture**:
  - Clarify criteria (e.g., only key concepts, diagrams allowed, no full sentences)
  - Set a strict time limit (10–15 minutes)
  - Optionally: exchange and critique another group’s questions
  - Discuss: Which questions require higher-order thinking?

Recommendations

- Clarify whether the **activity is formative or exam-relevant.**
- Encourage **higher-order questions** (application, comparison, critique).
- **In international settings:** provide examples of expected question formats.
- **Avoid overload:** limit length strictly.
- **Use** selected student questions **in a later quiz or review session.**
- Works well in technical and theoretical disciplines.

More information: Denis Sedlmeier, TUM

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

One-Minute Paper

At the end (or during) a session, students **write a brief response to a focused prompt** (e.g., “What was the most important insight today?” or “What remains unclear?”). The responses **provide immediate formative feedback and stimulate reflection.**

Complexity : 

Group size: large

Format: all formats

Learning objectives / benefits

- **Foster reflection** and consolidation of learning
- Encourage students to **identify key takeaways**
- **Reveal misconceptions** or open questions
- Provide **low-threshold participation** opportunity

Implementation

- **Timing:**
  - Last 3–5 minutes of class
  - After a challenging concept
  - Mid-session feedback checkpoint
- **Prompts examples:**
  - What is the central concept today?
  - What question do you still have?
  - How does this connect to previous topics?
- **Tools or Formats:**
  - Paper cards
  - Learning Management System submission
  - Anonymous digital tool
  - Chat entry in online sessions
- **After collection:**
  - Summarize patterns next session
  - Address common misunderstandings
  - Integrate into FAQ document

Recommendations

- Keep it **short and focused** (1–3 questions max).
- Make clear how **feedback** will be used.
- Do **not try to answer every single comment** individually.
- Use regularly to build reflection **habits**.
- In EuroTeQ contexts: **allow responses in simple English** to lower barriers.

More information: Denis Sedlmeier, TUM

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

Think-Pair-Share

Students first **think** individually **about a question**, then **discuss their ideas with a partner**, and finally **share insights** with the whole group. The structured sequence **lowers participation barriers** and activates all students **before plenary discussion**.

Complexity : 

Group size: large

Format: all formats

Learning objectives / benefits

- **Break passive** listening
- Promote **articulation and argumentation skills**
- Support **processing of complex** or controversial topics
- **Reduce speaking anxiety**

Implementation

- Plan placement:
  - After introducing a key concept
  - Before revealing a solution
  - When discussing case studies or ethical dilemmas
- Timing structure:
  - Think (1–3 minutes, silent reflection)
  - Pair (3–5 minutes exchange)
  - Share (selected inputs in plenary)
- In plenary:
  - Call on pairs, not individuals
  - Summarize patterns rather than every answer

Recommendations

- Give a **clear, cognitively activating question** (not recall only).
- **Silence** during the “think” phase **is essential** – protect it.
- **In large groups, collect answers via chat or polling.**
- Avoid overlong **sharing phase.**
- Particularly **effective in culturally diverse groups** where students hesitate to speak immediately.
- **Online/Hybrid adaption:**
  - Use breakout rooms (pairs or trios)
  - Provide written prompt in chat or slide
  - Clearly communicate timing

A short explanation video

More information: Denis Sedlmeier, TUM

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Buzz Groups

Students discuss a **focused question in small spontaneous groups** (3–5 participants) for a short**, intensive exchange** (“buzz”). The goal is **rapid activation, idea generation, or problem-solving** before returning to plenary discussion.

Complexity : 

Group size: large

Format: all formats

Learning objectives / benefits

- **Activate all** students simultaneously
- Generate **diverse perspectives** quickly
- Encourage **collaborative problem-solving**
- Support **peer explanation of concepts**

Implementation

- **When to use:**
  - After presenting a problem
  - Before plenary debate
  - To analyse a short case
  - To generate examples or applications
- **Procedure:**
  - Provide a very clear and focused task
  - Group building: depending on the set-up and time frame define groups
  - Set strict time frame (1–10 minutes)
  - Assign roles if helpful (moderator, note-taker)
  - Collect 1–2 key points per group
- **Online/Hybrid:**
  - Breakout rooms with visible countdown
  - Shared collaborative board
  - Clear instructions before splitting

Recommendations

- Keep tasks specific and manageable.
- **Avoid vague discussion** prompts.
- **Time discipline** is crucial.
- In large international groups, **define who works together** clearly.
- Combine with **follow-up synthesis** by the instructor.
- Ideal as an **energizer in longer sessions** (especially online).
- Group building: the easiest way is **“talk to your neighbor”** to create intercultural groups with different backgrounds and perspectives
- **Flexible time frames**: “What do you think? Exchange for one minute.”

More information: Denis Sedlmeier, TUM

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

Peer instruction

Many instructors notice that students feel they understand a concept while listening, but struggle when asked to apply it. Peer Instruction is an active learning method that uses **conceptual questions** and **peer discussion** to **deepen understanding**.

Complexity:

Group size: large classroom

Format: in-person or online

Learning objectives / benefits

- **Identify and correct misconceptions** through peer explanations
- Increase **active participation and engagement**
- **Improve reasoning skills** and the ability to articulate explanations

Implementation

Teacher prepares **conceptual questions** and provides resources

Students **work on the subject**

Teacher gives a **brief introduction to concept** or some information

Teacher asks **a question**

Students **vote individually**

Teacher **publishes the answers**

Students **discuss and justify their answers** in small groups

Teacher **polls again** after discussion

Teacher **explains the correct answer** and clarify misunderstandings

Challenges and recommendations

- This method is **time-consuming**: keep an eye on the clock for each stage
- Designing **strong conceptual questions** in the first stage of the process is crucial and challenging – not all questions work equally
- Some students are **reluctant to participate**: try to create an atmosphere of trust and the right to make mistakes

Further reading

- Eric Mazur, Peer Instruction: *A User's Manual* (1997).
- Crouch & Mazur (2001), *"Peer Instruction: Ten years of experience and results."*
- Mazur Group – Harvard resources on Peer Instruction.

More information: Latifa Berkous, l'X

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