

Learning Strategies

Teachers and trainers have a variety of options to help people learn. Traditional methods include lecturing and assigning readings. Most teachers also ask questions to stimulate reflection and discussion, and make assignments that ask learners to practice their developing skills. There are many valid ways to make sure learning takes place, and it is good for teachers to be proficient in applying them to create more pathways to learning.

Strategies are general approaches to achieving a goal. In education and training, the goal is to help people learn, so learning strategies are methods that teachers use to help their students succeed as learners. The common strategies discussed here are based on theory, research, and good practice.

To learn complex skills and knowledge, learners need more than information. They need to become active in the learning process, just as they would be active in their professions. Teachers need to challenge learners to think deeply about and to apply what they are learning to ensure they can use it later. Learning anything complex is much more than just memorizing, although memory might be involved. Complex cognitive skills include explaining complex concepts, analytical thinking, decision-making, creative thinking, problem solving, and evaluation. Most job tasks require a combination of these. Learning these cognitive skills requires practice using them during the process of learning.

Passive approaches to learning, like non-interactive lectures and readings, do not engage learners at the same level as applying cognitive skills, and are therefore likely to achieve less learning. Yet at some point during the learning process, lectures and readings will likely be useful for their efficiency at getting information across quickly. This is where blending strategies can help.

Blending learning strategies is similar to creating a nutritious and tasty meal—an appropriately blended variety is both healthier and more enjoyable. In most cases, one ingredient does not make a meal. We have many dietary needs, just as we need many cognitive skills to live and work in a complex world. Vitamins might be useful supplements to diets, but they are not as nutritious as whole foods because they lack nutritional complexity. Similarly, quick learning solutions are not as effective as the hard work required in active and authentic learning approaches.

The strategies discussed will include **Discussion** strategies, **Inquiry** strategies, **Experiential Learning** strategies, **Case-based Learning** strategies, **Project-based Learning** strategies, **Guided Practice and Feedback**, and **Lectures and Readings**. This is a longer reading, so you may want to read it in stages, taking time to reflect about each strategy before moving on to the next. As you read through the descriptions of the strategies, consider the following:

- When have you experienced the strategy as a learner?
- Did it help you to learn? Why or why not?
- How was your learning different from when other strategies were used?
- How have you previously used the strategy as a teacher?
- What opportunities do you have to use the strategy in your current teaching?
- How do the strategies overlap? How can they be combined during a single learning activity?

Discussion Strategies

General principle:

Present instruction around one or more questions or issues and encourage students to think deeply while they discuss them with the class. In teacher-centered discussion, the discussion is highly structured and guided by the teacher. In learner-centered discussions, the teacher allows the students more room to steer the discussion according to their needs and interests. In either case, the teacher should limit their lecturing or explanations to short, but critical points, and focus on interaction through discussion.

Rationale:

- Knowledge is developed not just by taking in information but by expressing it in one's own words. We have learned something when we can speak about it.
- Learning is not a private act; it is a social process. We learn more deeply by testing what we learn with others and receiving their feedback.
- Discussion teaches critical thinking and problem solving along with subject matter.
- Discussion allows deeper exploration of a topic, particularly when opinions or solutions may differ.
- Being a part of a discipline means being conversant in that discipline, being able to discuss it with colleagues.

Guidelines:

- In teacher-centered discussions, structure the discussion to encourage a variety of responses that lead toward a desired endpoint, guiding the discussion as necessary.
- In learner-centered approaches, keep discussion centered on the students contributions when possible
 - Encourage students to contribute even more than you. Facilitate and guide the discussion rather than only present your own ideas or show your knowledge.
 - When error or poorly-conceived statements come up, question them, but ask students to correct one other when possible. Ask the group if they agree rather than just correcting it yourself. This lets students test their knowledge.
 - Choose the best time for your "teaching moments." Wait to add to the discussion until it will be most instructive or will guide the discussion forward usefully.
- Discuss either as a full class or break students into small groups. Small groups encouraging ALL students to talk. Large groups tend to limit who will participate, but can bring out greater diversity if you facilitate well. Full group discussions take less time.
 - Small Group Option 1: Groups discuss the same topic, and allow a spokesperson from each group summarize to the entire class.
 - Small Group Option 2: Groups discuss different topics or aspect of a topic, and then a spokesperson shares to the class. This expands the topics covered.
- Hold discussions both in the classroom and online. For online discussion, use a discussion forum, email group, webinar, or community website.

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- Debrief discussions to encourage reflection. Together with the students, summarize, synthesize, and clarify conclusions.
- Document key points from the discussion on a whiteboard or digital space to preserve the outcome.

Content suggestions:

- Discussions can be structured in many ways:
 - After assigned readings on a complex topic, give students time to discuss what they learned from it, either in small groups or the full class. This allows both you and your students to check what they've learned.
 - Compare two descriptions or conceptual models of a phenomenon and discuss which does a better job at explanation.
 - Assign students to read a case study or other research paper and as a group critically evaluate its structure and results. Alternatively, compare two studies that differ and discuss them.
 - Conduct a debate or have students take on different roles and or points of view in the discussion.

Inquiry Strategies

General Principle:

Pose questions, problems, or hypotheses, or tell stories of problematic situations that will naturally engage students' curiosity. Then ask them to follow a process of inquiry or research. When time is limited, this can be a simple process taking only a few minutes: zeroing in on the key question, considering available information, analyzing it, and proposing solutions. When appropriate and with sufficient time, this can be more formal: to form a good research question, hypothesis or problem space; to gather and analyze data and information; and to develop conclusions or solutions.

Inquiry strategies are learner-centered. The inquiry should require students to identify or meaningfully use the information you want them to learn.

Rationale:

- Inquiry forms the basis of all meaningful learning. Meaningful knowledge always begins with a question or in experiencing situations that require a resolution.
- The skills required for an effective inquiry are needed in every profession. All workers need to be able to solve the problems they encounter and seek information to make decisions.
- Inquiry requires more than remembering facts, concepts, and principles, it also requires higher-level thinking skills such as critical and creative thinking, analysis and judgment, and problem solving and decision making.
- Questions establish a context for students to construct knowledge. Inquiry reflects how experts generate the body of knowledge in a discipline in the first place.
- Inquiry creates motivation. It sets up a natural drama based on seeking the answer to a question or resolving a puzzling phenomenon.

Guidelines:

- For critical content in your course, flip your planning question from “what do I want students to know?” to “what critical thinking should students be able to do?” Background knowledge can be provided as resources for the inquiry.
- Inquiries do not have to involve formal scientific research, but they can. Traditional laboratory exercises also apply inquiry-based learning.
- Group discussions can also be centered on an inquiry.
- “Problem-based Learning (PBL)” is a subset of Inquiry Strategies. In PBL, students work on complex problems that require judgment about good solutions, not one “correct” solution. They might require days or weeks to resolve, and demand much background reading.
- An inquiry might require the readings you already assign. In this case, inquiry questions might be reflection questions, questions that ask students apply readings to their personal context, link the content what they learned previously, or require them to do additional online or library research to probe deeper.
- Provide sufficient guidance for students new to inquiry processes. You may need to do a guided inquiry to demonstrate the process you expect. Support those having difficulties with their inquiries, but do not provide easy answers.
- If an inquiry is given as an assignment, require a written or oral report.

Content suggestions:

- For an inquiry assignment, choose or help students select interesting and rewarding inquiry questions:
 - Why do you think X phenomenon occurs more/less frequently in Y location? What are the key conditions required for X processes to take place?
 - How might you go about researching how or why X occurs?
 - What data would you need to forecast X? What observing systems should be in place for monitoring and forecasting X?
 - Which conceptual model would explain this weather data?
- A good Problem Based Learning strategy for an operational hydrology class might be, “Design an effective gauge system for flood warnings for this drainage basin.” In the PBL, the instructor can provide resources and strategies, and learners might partially self-assess their work by justifying their solutions.
- Transform what could be a lecture into a problem to be explored.
 - Instead of just providing a definition of fog and a description of the various mechanisms cause it, ask a question. “Here are 3 very different locations where fog occurs frequently under certain conditions. Consider what these situations have in common and how they differ. What can you say about the critical ingredients for fog formation?”
 - Instead of just describing the way observing systems work, ask students to investigate what data goes into a forecast of a particular phenomenon.

Experiential Learning Strategies

General Principle:

During experiential learning, students engage in real-world activities that require them to learn and apply knowledge and skills in the process of performing tasks or solving problems. During the experience, because they will be confronting new information and acquiring new skills that have immediate relevance, what they learn will be learned deeply. As much as possible, experiential learning is done in real world rather than a classroom. Experiential learning can be in the form of a project or a job task (such as an internship), and should include realistic challenges, risks, and consequences. Experiential strategies are learner-centered.

Rationale:

- All deep learning is grounded in experience—trying something out, reflecting about the results, and trying it again to get improved results.
- Students learn more useful skills in messy, real-world experiences, rather than a controlled environment. Only real-world experiences contain the kinds of complexity students will encounter outside the classroom.
- Students learn more deeply when they are emotionally engaged in what they are learning. Authentic experiences carry emotional weight.
- Learning is a social activity. Students learn more deeply when engaged with others practicing in the discipline they are learning about. A real-world environment offers many unspoken lessons missed in controlled instruction.

Guidelines:

- Find real-world opportunities for students in the discipline you teach. This can involve simply shadowing a practitioner, but ideally students could be given job tasks as well.
- Students should be independent as much as possible in the learning experience. Part of what they need to learn is resourcefulness, self-confidence, and independence.
- Experience without reflection might not transfer into lasting learning. Students should be encouraged to reflect on their experience. Kolb advises a 4-step cycle for experiential learning (see <https://www.simplypsychology.org/learning-kolb.html>):
 1. Experiencing: Active engagement in the experience
 2. Reflection: Thinking and discussing about the experience to identify what occurred and why, including problems, challenges, and implications
 3. Generalizing: Thinking about what can be taken away from the experience to use in other contexts. What lessons were learned?
 4. Applying: Using what was gained in the experience in new situations.These general steps are often performed almost simultaneously during active experiences. But teachers can highlight them to ensure they occur.
- Provide guidance and coaching, but avoid instruction. Fill in gaps only if you see they missed opportunities or need to be reminded of background knowledge.
- Field trips are not experiential learning unless they include extended application in the activities at the field location.

Content suggestions:

- When real-world tasks are not possible due to high risk or costly outcomes for mistakes, realistic shadowing can be used. This is not the same as simulation (see the next section). For example, students could be asked to make a weather forecast in the same timeframe and using the same data as working forecasters. To make it more authentic, student forecasts can be shared publicly in some venue, such as on campus or on an unofficial public website.

Case-Based Strategies

General Principle:

In case-based learning, students practice working through cases that represent real-world examples of situations. Cases should demonstrate the targeted problem solving and decision making situations you would want students to be prepared for. Case-based Learning is similar to Experiential Learning in that they are both based on real-world experiences and require reflection. However, cases are one step removed from the real-world, more contained and controlled than actual experiences, and more readily digestible as useable knowledge. Case-based strategies include simulations and role-play activities. Case-based strategies are active, but can be either teacher- or learner-centered.

Rationale:

- One important way people store knowledge is as cases that guide future actions. Decision making, particularly rapid decision making, is frequently done by comparing current situations to past ones, taking appropriate action, and then comparing results and adjusting if necessary.
- Learners need to reflect on their experiences and classify them to allow them to become case models useful for future decision making.
- People can learn from the experiences of others when they are shared as classifiable stories and cases.
- Learning is most effective when students are trying to achieve goals of interest to them, and to achieve clear outcomes, not learning for its own sake. Cases provide a good context for this.

Guidelines:

- Establish the intended learning outcomes before choosing cases. Cases should be chosen and designed to provide opportunities for practicing the targeted skills, retrieving information, and applying knowledge that demonstrate those learning outcomes.
- Cases can be full-fledged simulations, but they can be simpler. Simulations emphasize realism in the context of the case actions (realistic data and tools), and often in the consequences to decisions. But some instructional cases might require decisions only at key points in the case, or merely be descriptive, and for discussion.
- Simulations can be critical in preparing learners to make quick decisions in complex environments in which repercussions can be costly (e.g., flying a plane, forecasting or responding to an environmental threat).
- Descriptive cases should be structured to enable learners to recall them easier. Include all critical information to derive the principles they teach:
 - A specific time and date
 - A specific location
 - The people involved and their roles and goals
 - Solutions attempted and the challenges faced
 - Results of actions and decisions taken
 - Other situations in which the case might be a useful model
- Decide how students take actions in the case.

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- How many and which decisions do they have to make?
- How do they implement their decisions?
- Who and what do they interact with to make decisions (other students, the teacher, prepared data, learning resources)?
- How do they get feedback, and how can they use it?
- Provide resources that will help students understand the make decisions in the case. Resources can include textbooks and reference books, or online resources. You might provide coaching in the form of content and process guidance when necessary.
- Provide guidance in the form of other related cases or stories. If a learner is uncertain what to do, recall a related case. In other words, demonstrate the use of past cases to make decisions.
- Review the critical information of each case with students. Providing this reflective summary helps students transfer what they learn into useful case models.

Content suggestions:

- Find cases that are sufficiently complex to require difficult decisions, but that can be easily classified (context, phenomenon, barriers or difficulties).
- Find cases that differ along the dimensions of critical information, such as time, location, people, goals, problems, etc., as well as levels of difficulty.
- Cases might represent varying aspects of disciplinary practice—developing principles and conceptual models, expert decisions of a technical nature, and expert decisions with societal implications.

Project-based Learning Strategies

General Principle:

Project-based learning strategies are, in the broadest sense, also Inquiry Strategies, so much of what is said about Inquiry Strategies also applies here. In projects, students work individually or in small groups to produce a product. The product might be a report on the resolution of an inquiry or problem, but it might also include another tangible artifact—a plan, poster, presentation, digital media, or model. Like other active learning strategies, students are exposed to new information and practice skills in the process of completing the project—in other words, in a relevant rather than artificial context. Project strategies are learner-centered.

Rationale:

- Authentic activities like projects provide increased opportunities to develop practical skills and applicable knowledge for life-long use.
- Projects are a form of learning by doing, leading to deeper understanding through comprehensive application, not just listening or reading.
- Projects can develop broader knowledge and skills required in the process of producing a product and reporting on its outcomes.
- Projects, especially group projects, encourage the development of communication and interpersonal skills such as team work.
- Projects can be inherently motivating, offering an eventful beginning, middle and end to the learning experience, like any good story.
- Projects encourage growing commitment and independence.

Guidelines:

- For group projects, try to create a collaborative climate of mutual respect. Ensure that learners in groups contribute equal effort toward completion. Establish rules, and model collaboration and respect yourself.
- Introduce the requirements of the project well, including expectations and a rubric for how it will be evaluated.
- Demonstrate the value of the work required and challenge of completing the project.
- Ensure learners have access to the essential content and resources for developing the skills they need while engaged in the project.
- Allow learners the opportunity to adapt the project to their personal interests to increase their motivation.
- Include frequent opportunities for feedback and revision during the project, including self, peer and teacher formative assessment.
- If possible, include a public presentation of the project results.
- Assign projects that require use of important thinking and technical skills learners will need in their future professions.

Content Examples:

- Effective projects will be those that require application of knowledge to local problems, environments and working conditions.

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- The best instructional projects are those that contribute to meeting a learner's professional or academic responsibilities. In the case of trainers, this might be producing a training development plan for an actual training need. For forecasters, it might be developing a local case study applying the course content. For managers, it might be creating an implementation plan.

Guided Practice Exercises

General Principle:

In this teacher-centered strategy, a series of exercises are provided for the learner to practice simple to complex skills. In most cases, the exercises should be increasingly difficult and varied as the learner proceeds through them. The amount of supervision offered by the teacher might also be diminished during the sequence of exercises, increasing the difficulty and independence of the learner. Instruction may or may not be offered in between exercises. Feedback on exercises can reinforce instruction provided elsewhere, or provide new instruction.

Rationale:

- Mastery of many forms of information, skills, understanding and even more complex skills can require repeated practice.
- Repeated practice provides not only an aid to memory, but when the practice is done on exercises of different sorts and under differing conditions, it provides flexibility and the broader experience required to use learning in a variety ways.
- Guided practice exercises are assumed to be smaller scope and less authentic than cases, simulations, and projects, but they have the advantage of efficiency and a potentially greater number of types of practice.
- Guide practice exercises can be designed to accommodate learners at different skill levels, leading to a remedial or advanced path if appropriate.

Guidelines:

- Guided practice often requires a demonstration phase before the practice phase.
- Guided practice exercises require carefully prepared instructions to avoid confusion, frustration, or feelings of failure.
- Teachers need to factor in the variable time required by learners at different levels.
- The design of feedback to exercises can be as important as the design of the exercise itself. Feedback needs to correct errors, but also correct evident misconceptions and provide reinforcement.
- Provide just enough oversight to avoid frustration, more in the early phases of practice, and later just enough to allow independence to grow.
- Monitor progress to know when remedial exercises are required by learners.
- Guided practice can take the form of a scripted tutorial that provides instruction along the way. This can be more rewarding and less monotonous than doing all instruction first, and all exercises afterwards.
- Too many exercises can be repetitive and tiring, so practice sessions should be limited.

Content Examples:

- Simple to complex procedures are good candidates for guided practice. Instrument set up and maintenance, repairs, some software techniques, fundamental math and physics learning are all appropriate.

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- Data product analysis and interpretation can be learned well via a series of guided practice exercises that reveal varying kinds of difficulties or situations.
- Communication skills, such as writing a variety of products may call for repeated practice.

Lectures and Readings

General Principle:

Learners provide carefully structured information on the topics they need to learn. Good lectures are designed like good texts, sequenced logically, building slowly in complexity and providing space for understanding and reflection where possible. Lectures provide an opportunity for personal connection with learners, especially if dialogue is a part of the experience. For learners, it is a chance to relate to an expert in the field of study. Lectures are teacher-centered.

Rationale:

- Much of our knowledge is stored in the form of written texts, and can also be quickly shared through verbal means. Note that the words “lecture” and “reading” have the same root in Latin, where the word lecture literally means a reading.
- Lectures can provide opportunities for questions and discussion around difficult content.
- Lectures and readings can be motivating if they provide clear information along with compelling reasons for its utility.
- Readings offer learners a way to learn at their own pace, as well as opportunities to review and reflect.
- Lectures can provide a personal connection that is motivating and comforting.
- Lectures and readings can communicate course content at the right level for the particular learner audience they are design for, with an awareness of their background preparation.

Guidelines:

- A good instructional lecture or reading would include the following components:
 - Review: Going over previously learned content that is background for new learning. This helps to prepare learners by activating that knowledge.
 - Overview: Clarifying what will be learned by providing a high level summary of what will be learned. More than a bullet list of the outline, this clarification should explain how what is to be learned fits in the bigger picture.
 - Motivation: Stating why the new content is important. In addition to clarifying what will be learned, a good lecture or reading should demonstrate why it is important to learn. How does it help to explain or solve critical challenges in the field?
 - Explanation: Clear, well-structured information that builds logically toward a conclusion. The explanation might do this by showing how components of knowledge or a system are related, define and provide examples of key concepts and principles and their relevance to one another, describe the sequence of a procedure or the evolution of a process.
 - Assessment: A lecture should periodically and at the end check if learning is taking place by offering to take questions, anticipating questions and providing alternative explanations, or asking probing questions to learners. This can be done in readings as well, where reflection questions can be followed by further explanation.

- Another way for the lecture or reading to accomplish much of the above sequence is by structuring a lecture or reading around a question or problem. The problem itself can reveal the background and offer the WHAT and WHY, which can motivate learners to become engaged with the explanation.
- For variety and to allow opportunities for processing and reflection, intersperse readings and lectures with discussion, practice, and other forms of active learning.
- Don't assume learners will follow and recall everything you say in a lecture. Provide handouts as summaries of the content or give access to your lecture notes for later processing and review.
- For better learning, make both readings and lectures personal in their tone. Lectures and readings should not be like academic articles, unless of course the point is to provide practice in reading and interpreting academic articles. They should be offered at the right level
- Keep the number of individual topics limited, and make sure they are well related to one another. Organizing them around a single problem helps to show how the topics are related.
- When teaching, keep both readings and lecture short enough to allow the learners the opportunity to reflect and process what has been learned before moving to new content.
- Using visuals to accompany readings and lectures can be very helpful to explain complex relationships, as well as motivating imagination and attention.
- When lectures and readings are used, blend them with other more active learning strategies for deeper and more relevant learning.

Content Examples:

- Use readings and lectures sparingly, to make room for active learning approaches. But they can be used for almost any topic, particularly for introducing new information quickly.
- Use short lectures (or readings) to prepare learners for discussions and other activities, providing the background knowledge for better learning during these activities.
- Use readings not just to prepare learners for the classroom or practical phases, but also as take-away resources for use on the job—as job aids.