Design Question: What will I do to help students generate and test hypotheses about new knowledge?

21. What do I typically do to organize students for cognitively complex tasks?

The teacher organizes the class in such a way as to facilitate students working on complex tasks that require them to generate and test hypotheses.

**Teacher Evidence**
- Teacher establishes the need to generate and test hypotheses.
- Teacher organizes students into groups to generate and test hypotheses.

**Student Evidence**
- When asked, students describe the importance of generating and testing hypotheses about content.
- When asked, students explain how groups support their learning.
- Students use group activities to help them generate and test hypotheses.

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Element 21: What do I typically do to organize students for cognitively complex tasks?

Strategies

Student-designed tasks

Students design their own cognitively complex tasks that address class or personal learning goals. To begin, students answer the question, What are your initial questions and predictions about this content or information? Next, students respond to the following stimulus questions in order to identify the type of task that best addresses their question or prediction:

- Hypothesis I want to test?
- Problem I want to study?
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The first option applies to experimental inquiry tasks, the second applies to problem-solving tasks, the third indicates that the students should complete a decision-making task, and the final three correspond to the three types of investigation tasks: definitional investigation, historical investigation, and projective investigation.

Cooperative learning

The teacher uses the following guidelines to govern the use of cooperative learning during cognitively complex tasks:

- The teacher should design structures for group and individual accountability.
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- The teacher should specify clear roles and responsibilities for all group members. Group roles should rotate so all students have the opportunity to fill various roles (such as facilitator, summarizer, questioner, and so on).
- The teacher should use a variety of grouping criteria, grouping structures (such as formal and informal groups, ad hoc groups, long-term groups, and others), and grouping sizes (for example, whole-class instruction, group work, individual instruction, and independent learning),
and he or she should ensure that the grouping practices make sense in the larger scheme of classroom activities and instructional segments.

**Academic notebook charts, graphs, and tables**

Students track their progress on class or personal learning goals using a bar or line graph kept in a section of their academic notebooks.

**Think logs**

Students use think logs to reflect on the specific cognitive skills (for example, classification, drawing inferences, decision making, creative thinking, and self-regulation) they are learning as they complete cognitively complex tasks. Students respond to prompts such as the following:

- How might you explain classification to a friend?
- Describe an inference you drew today.
- With what aspects of the decision-making process are you most comfortable? With what aspects are you least comfortable?
- What might be the components of a self-regulation plan for your own learning?

**Journals**

Students keep task-specific journals (or designate a section of their academic notebooks) to record reflections on their learning as they complete cognitively complex tasks. They might answer questions such as the following:

- What is the purpose of your cognitively complex task?
- To what extent has your cognitively complex task enhanced your achievement of the unit learning goals?
- What questions did your cognitively complex task raise for you today?
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**Peer response groups**

Students work with peers to give and receive feedback on their cognitively complex tasks. To ensure equal participation and consistent feedback, the teacher assigns roles to students and uses scoring scales or checklists to ensure similar standards for each member of the group.

**Self-evaluations**

After completing a cognitively complex task, students engage in a formal self-evaluation process using data from their academic notebooks, final products or performances, and peer or teacher feedback. If appropriate, the teacher might ask the students to suggest what score or grade they think they deserve for their project.
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Advanced students volunteer to help students who need just a little assistance to move up to the next level. Advanced students should probably not tutor severely struggling students (who need intensive help from the teacher), but the teacher might pair them with students who need only a small amount of help or guidance to achieve competence or proficiency.

**Technology Links**

- Direct students to websites that encourage collaboration. Some websites are designed to facilitate online conversations, while others allow students to collect information and work together to produce papers and presentations (for example, www.wikispaces.com or https://docs.google.com).

- Ask students to keep think logs and journals online or on a school server. This allows the teacher to monitor student entries and provide feedback when necessary.

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Design Question 4
What Will I Do to Help Students Generate and Test Hypotheses About New Knowledge?

Module 12

Engaging Students in Task Design, Cooperative Learning, and Self-Evaluation

This module emphasizes the power of having students design their own tasks for the generation and testing of hypotheses. When students participate in designing the kinds of project-based tasks described in the previous module, they reap many benefits. Specifically, students develop a heightened sense of motivation and efficacy when they are allowed to engage in self-designed authentic tasks that require them to transfer knowledge to the world beyond the classroom. The more learning and assessment tasks are reality based, the more students understand curriculum content at higher levels. A fundamental condition for higher levels of understanding is that students engage in self-monitoring, self-evaluation, and self-regulation. This module will also revisit a recurring theme in The Art and Science of Teaching—the power of shared experience and cooperative learning as essential building blocks of the teaching-learning process.

Reflecting on Your Current Beliefs and Practices

Before examining the strategies in this module, take some time to reflect on your current beliefs and practices by answering the following questions:
1. How do you ensure that students take a direct role in task design, when appropriate?

2. To what extent do you attempt to incorporate student interests into task design?

3. How do you encourage students to engage in ongoing processes of self-monitoring, self-regulation, and self-evaluation?

4. How do you encourage students to engage in cooperative learning processes and structures to reinforce their understanding and higher-order thinking?

Recommendations for Classroom Practice

This module addresses the following strategies for Design Question 4:

- Engaging students in task design
- Using cooperative learning to enhance students' work with performance tasks and projects
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Recommendations for Classroom Practice

This module addresses the following strategies for Design Question 4:

- Engaging students in task design
- Using cooperative learning to enhance students' work with performance tasks and projects
- Encouraging metacognition and self-regulation
Engaging Students in Task Design

When students design their own tasks, it is important for the teacher to work closely with them so that the tasks and projects are not simply interesting things to do but represent genuine contributions to the students' learning. We suggest that as students progress from initial knowledge and skills acquisition toward growing levels of proficiency and independence, they should be asked to address the following question:

What are your initial questions and predictions about this (content/information)?

This initial question helps students focus on a topic of personal interest within the framework of the unit.

Next, students would try to determine which type of task would best address their questions and predictions. The following stimulus questions can be used to help students identify the type of task they will design:

Relative to my questions and predictions, is there an important . . .

• Hypothesis I want to test?
• Problem I want to study?
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As the following examples will confirm, this process can be used in a wide variety of subject areas.

English/language arts lends itself to student-generated problem-solving and decision-making tasks. For example, students might independently identify a specific problem or decision encountered in a work of literature they have studied and develop a presentation or performance that models how they have addressed the identified issue. Students can also enhance their oral, written, and media-based communication skills via experimental-inquiry tasks they design to test a hypothesis they have generated about key issues confronting them, their school, or their community (e.g., ways to improve school spirit, ways to improve cafeteria food selections, strategies for eliminating neighborhood violence).

Social studies is particularly well suited to student-generated investigation tasks. For example, some learners might choose to investigate the historical developments associated with a major event or process they have encountered. Others might want to learn more about an intriguing concept or a big idea such as democracy, the rule of law, individual liberties, or competing concepts of government. Adventurous students can be encouraged to work either independently or collaboratively on projective investigations. In a history class, for example, students can reflect upon such questions as these: How would our world be different if X had not happened? What might have happened if the British
had won the American Revolutionary War? How will current economic trends play out for future generations?

Students in a wide range of science classes can apply their developing knowledge and expertise to authentic, real-world decision-making and problem-solving activities, especially ones that reflect their personal interests, values, and priorities. In biology, for example, students might generate and test hypotheses about local ecosystems and develop an action plan for evaluating the quality of living systems and resources within that ecosystem.

Students' experiences in world language courses can be enhanced through opportunities for independent investigations into aspects of the culture, history, and current events of the world regions that use the language they are studying. How, for example, do teenagers who speak the language being studied experience adolescence in their particular regions or cultures? What accounts for idiomatic expressions and slang unique to a culture—or universal across cultural and linguistic lines? Students' literary experiences can also be augmented by allowing them to choose independent reading selections, with accompanying research and written analyses of a particular work or genre of literature. Finally, problem-solving and decision-making scenarios can be enriched by allowing students to choose the particular issue they wish to present on or respond to using the foreign language they are studying.

Culminating projects and performance tasks involving technology offer a wonderful context to allow students to formulate and test hypotheses. Such projects and tasks also allow students to use one or more of the complex reasoning tasks (experimental inquiry, problem solving, decision making, investigation) to complete products and performances involving the technology. Potential is also rich for integrated or interdisciplinary projects involving technology applied to a particular content area. Students investigating a historical event, individual, or trend, for example, might use PowerPoint and related presentation technology to present their conclusions. Whole-class projects can also use technology, including the creation of class Web sites showcasing individual contributions by each student in that classroom.

In health and physical education, teachers might encourage students to understand the applications and personal implications of health and physical fitness strategies and concepts via independent projects of their own design. Students might formulate personal hypotheses about how a change in diet or physical activity might affect them or members of their family. In turn, they can design ways to implement the identified changes and share their effects with the rest of the class. A wonderful independent project in this area might involve students' development of a personal fitness plan that can be modified throughout the academic year. As students learn diet, health, and fitness information and skills, they can adjust the plan and collect personal performance and health data to monitor its effect.

Visual and performing arts allow for a wide range of student choice concerning end products and performances. Arts showcases are invaluable settings for students to display
and explain individual artistic artifacts or performances that reflect independent choice, vision, and sensibilities. The entire range of visual arts, for example, can become an ideal venue for students to experiment with media and methods for expressing their personal insights and observations. Similarly, student-created individual performances involving knowledge and skills taught in a performing arts class (e.g., a personal musical performance, dance, multimedia or dramatic presentation) always involve elements of decision making and problem solving.

Examples

*Elementary Mathematics.* At the end of a unit on computing the area of irregular shapes, this elementary mathematics teacher asks students to solve a problem of their own design using the techniques addressed in class, particularly those involving nonstandard units of measure.

*Secondary Technology.* After addressing advances in personal computers over the last 10 years, this secondary technology teacher invites students to identify and research some aspect of the history of computers (historical investigation), the future use of computers (projective investigation), or the current use of computers (definitional investigation).

<table>
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<td>Imagine you are a student in your class going through a specific unit you have taught. Describe an authentic task you would design.</td>
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Using Cooperative Learning to Enhance Students’ Work with Performance Tasks and Projects

Student-designed tasks are ideal for group interactions. Culminating performance tasks and projects—especially those that allow for student choice and expression of personal interests—can use a range of cooperative learning structures and processes. Groups can easily collaborate on gathering issues-related information, organizing that information, taking a shared position regarding its meaning, and finding ways to express conclusions to the entire class.

Culminating performance tasks and projects can involve a combination of independent and cooperative learning activities. Cooperative groups can gather information and organize it for related topics. As a follow-up, however, students can perform all other components of a task (e.g., an investigation, an experiment, a problem-solving scenario,
a decision-making process) individually. Given that all tasks related to hypothesis generation and testing involve prediction, each student can generate a personal initial prediction and contrast final conclusions with the initial prediction generated by the group.

As teachers engage students in cooperative tasks, they should keep in mind the following important tenets of cooperative learning:

- The capacity of cooperative learning to promote positive interdependence among learners within a classroom.
- The critical need for any cooperative learning structure or group to be grounded in both individual and group accountability—that is, avoiding the phenomenon of one or two group members doing the bulk of the work.
- The need to review with students and provide ongoing coaching on their use of such interpersonal and group skills as active listening, conflict resolution, restraint of impulsivity, summarizing and paraphrasing, and time management.
- The imperative of ensuring that roles and responsibilities be shared and varied at different times; for example, a group facilitator one day might assume the role of the group recorder the next.
- The need to use a range of cooperative learning structures and practices, including (1) using a variety of criteria for grouping students; (2) establishing base groups as well as informal and formal work groups; and (3) using cooperative learning to complement overall class learning practices (i.e., in combination with whole-group and independent learning processes), not as an exclusive instructional practice.

As the following examples suggest, cooperative structures can be used in a variety of subject areas in the context of student-designed tasks.

In English/language arts, cooperative learning can be easily integrated into a variety of teacher- or student-designed tasks and projects. For example, students might work in jigsaw cooperative learning groups to form expertise on a particular topic or subject area concentration. After teaching the rest of the class what they have learned as a cohort, the groups can then disband and allow for individual investigation. Such investigations might involve discovering the solution to a problem or making a key decision related to a theme or specific work of literature studied. Cooperative learning structures are ideal for allowing students to share information and expertise, particularly what they may have learned about a particular author, literary era, genre, or trend.

In history, students can form pairs, triads, and larger cooperative learning groups to research and report back on key aspects of history that are not presented in detail in the course textbook. Similarly, cooperative learning groups can become experts in a particular body of information needed for a problem-solving or decision-making scenario or case study. A cooperative learning group can also be useful in implementing curriculum tiering
and compacting. For example, a group of students might have a shared interest in music. This group might investigate the music of each era studied during a course, reporting to the entire class throughout the year as part of class discussion and study. Similar expert groups might investigate painting, architecture, or practical arts from various eras.

In science, whenever students are working on experimental-inquiry tasks conducted in lab settings, they must be able to work collaboratively to frame hypotheses, make observations, collect and analyze data, and report results. Cooperative learning processes are especially useful tools for enhancing students' engagement in performance tasks and projects involving case studies and authentic, real-world scenarios. In a science WebQuest involving students' exploration of biomes around the world, for example, members of a cooperative learning group can assume various roles (e.g., explorer, scientist, statistician, regional inhabitant), each contributing to the group's observations, data monitoring, and final presentation of conclusions. Science fair projects can also involve cooperative learning processes, including paired or team-based projects that allow students to expand their access to resources, data sources, texts, and technologies.

In foreign language classes, group-oriented cooperative learning projects are ideal settings for students to enhance their communication skills in the language they are studying. Student-designed projects involving cooperative learning cohorts can range from a cohort study of a historical era involving a region or country speaking the studied language to group performances and presentations focusing on a variety of issues, such as the following: a cultural phenomenon, a comparison of lifestyles in two regions or countries, or a dramatization of a visit to a region or country. Ideally, cooperative learning groups can be established at the beginning of an instructional cycle (e.g., at the beginning of a semester), with the same group spiraling their language skills throughout that cycle. Initially, groups can engage in small dialogues and spontaneous scenario reactions using the language. At key juncture points throughout the semester or year, they can design original ways to synthesize key learnings (e.g., group-generated performances, debates, dramatizations, and presentations) and use the language with growing levels of spontaneity and fluency.

Examples

**Elementary Composition.** This elementary composition teacher organizes students in cooperative groups to write a composition of their own design. Students in each group must be prepared to show how they took on a variety of roles throughout the project (e.g., proofreader, fact checker, information gatherer).

**Secondary Health.** Students in this middle school health class are formed into cooperative groups to identify and carry out a project that applies key concepts addressed in class to real-life health issues the students face.
Activity Box

Using the task you designed for the previous activity box, describe how cooperative grouping might be used to help you complete the task.

Encouraging Metacognition and Self-Regulation

Student-designed tasks present ideal venues for students to improve their use of such lifelong metaskills as self-regulation, time management, and goal setting. The following are specific techniques teachers can use to enhance students' self-regulation, self-monitoring, and self-evaluation. Although these strategies can be used for a variety of tasks, they are particularly useful in culminating performance tasks and projects, especially when students have a role in their design and development.

Use of Scoring Scales (Rubrics)

As suggested in Modules 2 and 3, students benefit from using scoring scales. For long-term performance tasks and projects, each evaluation criterion should be assigned a scale as described in those modules. Ideally, students should work with the scales throughout the time they are completing a performance task, monitoring how they are progressing from Basic to Proficient to Advanced levels on the scales.

Academic Notebooks for Data Collection and Analysis

Throughout an academic year, students can collect and analyze data reflecting their levels of proficiency and competency in relationship to key evaluation criteria. An entire section of their class notebook can be devoted to charts, graphs, or other visual representations of their progress toward learning goals that have been addressed in different units (see Module 4). When students are completing independent performance tasks and projects—especially those they have helped to design—teachers need to coach and to support their ability to self-monitor relative to the learning goals associated with the task. This process can help students see how successful they have been in moving from initial acquisition of knowledge and skills toward growing levels of independent use and understanding.
Journals and Think Logs

These metacognitive tools can greatly assist students in reflecting on what they are learning, why they are learning it, and barriers or problems that may be impeding their progress. Journal activities, for example, can be effective for lesson closure. Generally, these activities are open-ended written reflections, usually taking no more than three to five minutes at the end of a lesson segment or class. These activities provide students with opportunities to comment and reflect on lessons and their reactions to them. The teacher may choose to pose specific questions for particular journal items: What was the purpose of today’s lesson? To what extent did it enhance your achievement of our unit’s learning goals? What questions did it raise? What problems, if any, did you encounter?

A variation of the reflective journal is the think log. This approach requires a more focused response from students, asking them to assess and evaluate their use of specific thinking skills, processes, and habits of mind during a particular lesson, using questions such as these: How effectively did you use the skill of classification in today’s lesson? To what extent did you incorporate the elements of the decision-making matrix in your work today? How well did you apply one or more of the following habits of mind during this lesson: self-regulation, critical thinking, creativity?

Interviews with Students

Students can benefit from periodically engaging in formal and informal interviews conducted by their teacher. As they work on culminating performance tasks and projects, for example, the teacher can take one or two students aside and ask them how they are progressing toward achieving their long-range goals. Such informal interview strategies are especially useful during visits to the media center or when students are using technology independently (e.g., online searches, WebQuests). At key juncture points throughout the time students are working on independent projects, however, a more formal interview process might prove useful. Such interviews should be preceded and accompanied by a checklist or other scoring tool. Students should be clear about the kinds of interview questions the teacher may pose and how they relate to the purpose and goals of the project. It is also useful to incorporate the project’s scale (rubric) as part of the discussion.

Peer-Response Groups

Peer coaching is always a useful process to enhance student learning, especially during the development of independent performance tasks and projects. Formal peer-response groups can be conducted periodically to allow students to share drafts of their work in progress, eliciting peer feedback and coaching advice on maintaining strengths and eliminating possible weaknesses. The Bay Area Writing Project’s “P-Q-P” protocol is a useful tool for students’ work with peer-response groups. Students should receive
modeling and shaping opportunities to (1) present praise, followed by (2) questions they would like answered about the work in progress and (3) polish suggestions—recommendations for possible modifications of the work in progress before it is submitted in final form. This approach can also enhance students' overall ability to provide objective, formal feedback. It also creates a sense of safety and community within the peer-response group, ensuring that students receive praise first and objectively framed questions second, with any critique or suggestions for modification as a final part of the process.

**Formal Self-Evaluations**

After students complete significant projects or performance tasks, it is useful to give them the opportunity to complete a more formal self-evaluation. Ideally, this self-assessment will be tied to the evaluation criteria articulated in the scale used throughout the project. Students should also be encouraged to use data from their academic notebooks to justify their self-evaluations and suggested grades (if appropriate). The more opportunities students have to become self-evaluative, the greater their understanding of the learning goals and related evaluation criteria for which they are accountable.

**Examples**

*Elementary Language Arts.* While students are working on their projects during class, this language arts teacher periodically calls each student up to her desk. She asks the students to evaluate their level of effort and progress on their projects. The teacher records students' responses and then uses these responses as the basis for subsequent conversations with them.

*Secondary Science.* Periodically, this science teacher collects students' academic notebooks and makes comments about each student's progress. She conferences with each student by going over her comments and elicits student input regarding the accuracy of those comments.

**Activity Box**

Which of the suggestions in this section most closely resembles what you have done in your class to enhance students' metacognitive skills? Describe how it is similar to the activities you have used.
Checking for Understanding

Use the following rating scale to assess your current level of understanding of key strategies and processes presented in this module:

4 = I understand and already fully implement this strategy in my classroom.
3 = I understand this strategy, but I need to practice using it in my classroom.
2 = I can explain this strategy, but I am not fully confident that I can use it.
1 = I do not understand this strategy, and I do not currently use it in my classroom.

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   Based on my rating, I may need to revisit the following:

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