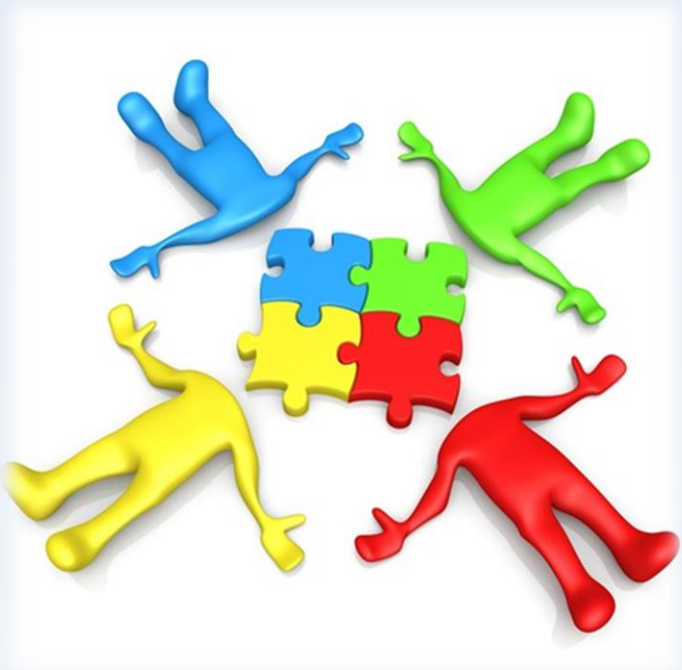
Constructivist Learning Training Manual

New Generation Schools Programming



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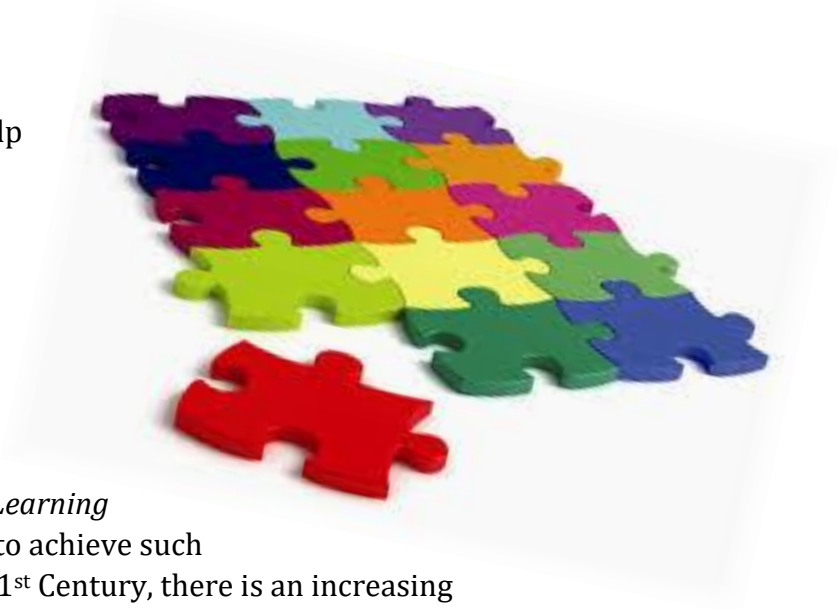
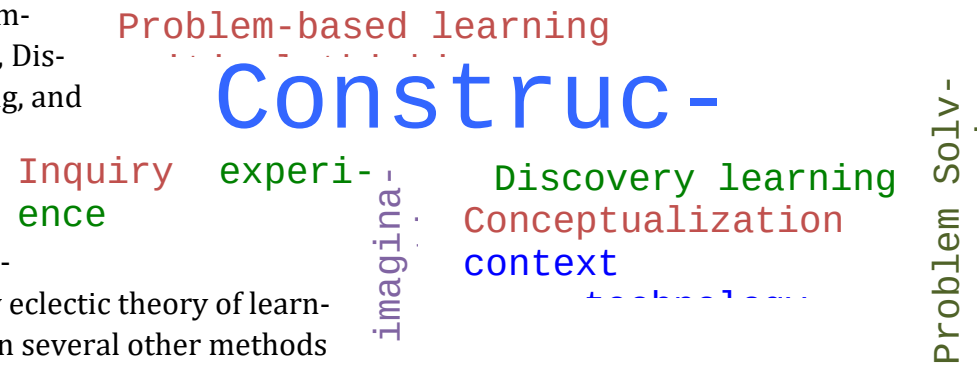
1. INTRODUCTION

1.1 Overview



General: This manual seeks to help Cambodian educators shift their way of teaching away from 'passive learning' models in which students are thought of as 'receptacles' of knowledge to a new approach in which students are active 'constructors' of new knowledge. A theory of learning known as *Constructivist Learning* is put forward as an ideal vehicle to achieve such change. As Cambodia enters the 21st Century, there is an increasing need for the education system to produce a work force that can think critically, solve problems, and work collaboratively. Mechanized teaching approaches of the past that focus heavily on rote learning are singularly ill-equipped to meet these needs. Constructivism has arisen as a response to such challenges.

Constructivism and Other Theories of Learning: Constructivism is a very broad theory that takes in many related concepts. While the central feature of the approach is all about the ability of students to manipulate concepts, there are many related elements of the approach that include critical thinking, problem-solving, the need for collaborative learning, and intensive use of technology amongst many others. Constructivist learning also subsumes several other teaching methods with similar goals such as Problem-based learning, Discovery Learning, and Inquiry-based approaches. Thus, Constructivism is a very eclectic theory of learning that takes in several other methods of teaching.



Constructivism and Technology: Although Constructivist Learning has been around for a long time, its relevance has greatly increased as the world enters the information age. Information technology has amplified the potential of Constructivist Learning Approaches to promote collaborative learning (e.g., through networking), to construct and synthesize new information (e.g., through PowerPoint presentations), and solve problems (e.g., through data processing programs that can find relationships, sort data, etc.). Thus, the use of technology can be a great tool to help students manipulate concepts, which is a central feature of the Constructivist Learning

approach. Because the manipulation of concepts is one of the key features of Constructivist Learning, it is highly suited to promoting critical thinking, one of the most important skills required for an information age workforce. There are, therefore, very close connections between ***Constructivist Learning, Technology,*** and the ***Needs of a 21st Century Workforce.***

Target Groups: The intended target audience of the training program described in this manual is secondary school teachers who are engaged in the instruction of adolescents in Grades 7 to 12. Nevertheless, the contents of this training program can also easily be adapted to teachers teaching at any grade level. The manual is intended to help teachers better meet the learning needs of the 21st Century by changing their role from a top-down teaching approach to one of a 'learning facilitator.'

1.2 Purpose and Content of This Manual

The present manual has been developed as a Training of Trainers (ToT) document to assist in the preparation of secondary school teachers to utilize Constructivist Learning methodologies in their classrooms. This speaks especially to the need to help teachers to focus on promoting higher order thinking skills when learning about specific lessons across all subjects. This includes the skills of Analysis, Synthesis, and Evaluation.

The manual contains a set of user-friendly *Session Plans* to guide a trainer in presenting a program to introduce teachers to some of the basic concepts of Constructivist Learning. Each session plan is set out with a suggested time frame, statement of needed preparation, useful materials and resources, and learning objectives. The manual also contains a set of *Participant Course Materials* that should be provided to teachers participating in the training program so that they can use these as reference documents after the conclusion of the training workshop.

Relevant Content: The content of this manual has been designed with the following outcomes in mind:

- Participants can define Constructivist Learning and the key principles that underlie it.
- Participants can demonstrate that they understand how to use concrete activities through which to implement Constructivist Learning Principles.
- Participants can explain how we resolve the tension between open-ended learning tasks that Constructivist Learning promotes and the needs to assess students' knowledge through standardized assessment.
- Participants can explain how to organize the institutional context at their school to promote Constructivist Learning.

1.3 Intended Applications of Constructivist Learning in Cambodia

The present manual has been designed especially for teachers in a *New Generation School* who have access to significant amounts of school-based technology and who have the freedom to experiment in how and what they teach. Although technology is not essential for an effective Constructivist Learning Classroom, it can greatly amplify the effective implementation of Constructivism, as noted above. This access to technology refers to access to research stations, LCD projectors, m-learning facilities, and new educational software that is particularly well-suited to active learning. Similarly, teachers in other state schools that are not accredited as *New Generation Schools* may also find it possible to adapt many aspects of Constructivist Learning to their classrooms, even in the absence of access to technology. Teachers should discuss with their school director and colleagues how this might be done, based on the guidelines presented in this manual.

Finally, it should be noted that this manual is only intended as a short introduction to Constructivist Learning Principles. Many teachers spend months and years on perfecting their capacity to employ such principles effectively in the classroom. Thus, it is important to remember that while this manual can serve as a means for teachers to become familiar with basic Constructivist Learning Principles, it will require many years of practice and mentorship to perfect the techniques presented.

2. EXPLANATION ABOUT HOW TO USE THIS MANUAL

This manual uses the following standard symbols to make the manual as user friendly as possible for the trainers using it. These symbols quickly convey the kinds of activities to be used with participants for each step of each session plan.

Timing Required for the Lesson

Pre-Training Preparation: Contains information on how to set up your training area for learning activities. It also gives suggestions on how to organize materials needed for the activity.

Materials Needed: This provides an overview of necessary materials. Most of the time these will be very basic things, like pens or paper. Other material in the training sessions will be provided through handouts that are attached in this manual. Sometimes they need to be duplicated by the trainer.

Learning Outcomes: Gives a statement of what should have been achieved and assessed at the end of the session.

Steps and Process Icons

Section 3 of this manual provides a series of training sessions on how to train the primary school teachers who are expected to employ Constructivist Learning techniques in their classrooms. The symbols below are used to help guide the actual training session. These symbols will tell the facilitator quickly what sorts of activities need to be planned for in this part of the training session. This section of the manual includes possible activities, stimulating questions, examples to clarify exercises and optional extra tasks. Although it is advisable to read through the whole lesson clearly from the beginning, especially when used for the first time, trainers can easily see what he or she has to do because of the icons used.

Action to be Taken: This symbol indicates that the facilitator must take a concrete action such as passing out a Handout, re-arranging desks, organize groups, etc.

Questioning Behavior: This indicates that the facilitator needs to ask a key question to the participants as a prelude to an activity or discussion.

Discussion: This symbol indicates that the facilitator must lead a discussion or allow participants to discuss something in their groups.

Writing Tasks: This symbol indicates that the participants need to write something on poster paper, complete an exercise, or other written task.

Explanation: This symbol indicates the facilitator must explain something to participants.

Facilitator Session Plans

Lesson 3.1- What is Constructivist Learning?

Lesson Time: 2 Hours and 30 Minutes

Trainer Preparation:

- Write up the Learning Outcomes of the lesson on a sheet of poster paper to introduce the lesson.
- Make copies of **Handout 1:** *Links between Constructivism and Other Learning Theories*
- Make copies of **Handout 2a:** *Defining Constructivist Learning*
- Make copies of **Handout 2b:** *Key Principles in Constructivist Learning*
- Make copies of **Handout 3:** *Why Constructivist Learning is Effective*
- Copy each Constructivist Learning Principle (shown in Handout 2b) onto a half of a sheet of poster paper. Leave space at the bottom of each sheet for participants to write in examples.

Resources/Materials:

- Poster paper, marker pens
- Poster sheet summarizing the learning outcomes of the lesson.
- **Handout 1:** Links between Constructivism & Other Learning Theories
- **Handout 2a:** Defining Constructivist Learning
- **Handout 2b:** Key Principles in Constructivist Learning
- **Handout 3:** Why Constructivist Learning is Effective
- Poster Paper Sheets with a Key Principle written on it

Learning Outcomes:

- Participants can **explain** key principles of Constructivist Learning and in particular the relationship between Constructivism and other learning theories.
- Participants can **give examples** of concrete activities that exemplify key principles underlying Constructivist Learning.
- Participants can **create a diagram** that expresses their interpretation of the relationships between the key principles that define Constructivist Learning.
- Participants can **explain** why the Constructivist approach to learning is more effective in terms of increased recall and understanding.
- Participants can **identify** 'active involvement' activities that will reinforce more passive activities.

Training Session Plan

Outcomes of the Lesson

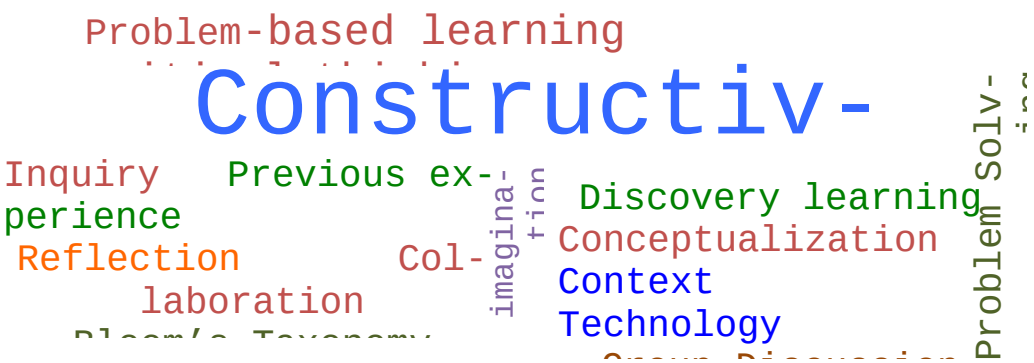
Place a sheet of poster paper up on the board that summarizes the learning outcomes for the lesson. Explain the outcomes and that this is what the participants should be able to do at the completion of the lesson.

Introducing Constructivism as an Eclectic Theory

The facilitator should start this session with an explanation of the central idea behind Constructivist Learning, which is suggested by the name itself – 'construct.' That is, **Constructivism is all about the construction and manipulation of concepts,** hence the name of the theory.

Constructivist Learning is a very eclectic theory that takes in many elements. This includes concept building (the core principle), as well as the need for collaboration, reflecting on past experience, the role of technology, imagination, and other factors.

Pass out **Handout 1:** 'Links between Constructivism & Other Learning Theories' to illustrate these connections.



Next, lead a guided discussion about key elements shown in the diagram above, asking how these are related to the principle of 'constructing' concepts. Try not to present this information directly to participants but to arrive at conclusions based on question and answer. The facilitator should probe to check to see how much participants already know about these other concepts and theories (e.g., Discovery Learning, Problem-based Learning, etc.). Some key questions are provided at the bottom of **Handout 1.**

During the *Question & Answer* activity, use the following information to help you guide participants to the right answers without telling them overtly:

- ***Problem-based Learning:*** Solving problems requires that we first reflect on our previous experience and new contexts to find or 'construct' a new idea that solves the problem. Reflecting on one's previous experience to find new ideas is a key part of Constructivism.
- ***Inquiry-based or Discovery Learning:*** Constructivist Learning pro-

motes the idea that we can remember things more effectively if we discover them ourselves through discussion, experimentation, and other active learning strategies.

- ***Bloom's Taxonomy:*** Constructivist Learning focuses heavily on thinking skills at the higher end of the taxonomy including Analysis, Synthesis, and Evaluation.
- ***Critical Thinking:*** Analysis, Synthesis, and Evaluation are all sub-skills of Critical Thinking.
- ***Collaboration:*** Working with others stimulates the exchange of ideas through discussion. Discussion enriches the number of concepts to manipulate and increases the likelihood that students synthesize unique ideas.
- ***Technology:*** Information technology has amplified the potential of Constructivist Learning Approaches to promote collaborative learning (e.g., through networking), to construct and synthesize new information (e.g., through PowerPoint presentations), and solve problems (e.g., through data processing programs that can find relationships, sort data, etc.). Thus, the use of technology can be a great tool to help students manipulate concepts, which is a central feature of the Constructivist Learning approach.

Defining Constructivism and the Key Principles That Support It

Start this session by passing out **Handout 2a:** 'Defining Constructivist Learning.'

Provide a concise explanation that emphasizes that 'constructivist learning' requires the creation of new concepts by the student. When presented with a problem or set of conditions, students 'reflect' on these conditions, compare them with their previous experience and knowledge, and finally create a new concept.

What is Constructivist Learning?

- Learning is active & self-directed
- Learning that builds on previous knowledge and experiences
- Reflecting on associations between concepts to make new concepts
- Exchanging ideas through collaboration enriches the idea creation process

'Constructing new concepts through collaboration and an exchange of ideas'

We can present this process as an equation, written on the board:

Self-direction + Reflection on Problem/Previous Knowledge + Collaboration = Constructivist

Try doing an example of this process together. For example, provide an example of an analogy:

Example: ***Father*** *is to* ***Son*** *as* ***Mother*** *is to* ***Daughter***

Using this example and others, ask participants to create 4 new analogies that show a similar relationship. This exercise is explained in **Handout 2a.**

Give participants about 15 minutes for this exercise and then ask each group to write their analogies on the board. Review them as a large group to check for consistency. Then, ask participants to complete the follow-on exercise that analyzes the analogy creation process.

After a short discussion about the analogies, carry out an analysis about the elements of constructivist learning that this exercise demonstrated. Do this as a large group. For example, ask participants the following guided questions:

- What part of this exercise demonstrated 'self-direction'?
  Answ*: Participants chose the analogic pairs to write by themselves.*
- What part of this exercise demonstrated 'reflection' on previous knowledge?
  Answ: *Participants reflected on the examples given by the facilitator and applied this knowledge to a new task.*
- What part of this exercise demonstrated 'collaboration' ?
  Answ: *Participants had a discussion among themselves and came up with more diverse analogies than they might have done if working individually.*

This exercise was an example of 'constructivist learning.'

Key Principles of Constructivist Learning

Write out the 4 Key Principles underlying Constructivist Learning on the board.

Give as complete an explanation of each one based on the information provided in **Handout 2b** as you can but without providing any examples. Do NOT distribute the handout at this stage of the lesson.

Next, pass out the sheets of poster paper with the Constructivist Learning Principles written on them. Each group should receive one or two sheets with a principle written on it and some space at the bottom for examples. ➔ ➔ ➔

Ask participants to write two or

Interactive learning – people naturally learn and work collaboratively in their lives. Interactivity provides a way to motivate and stimulate learners.

Give some examples of this principle at work:

- ???
- ???
- ???

three examples of an activity that exemplifies the principle at the bottom of each sheet. Give about 5 to 10 minutes for this activity and then discuss each group's examples in the large group.

Next, pass out **Handout 2b:** 'Key Principles of Constructivist Learning' and compare the examples provided in the handout with those that each group developed. Try to reconcile any possible differences.

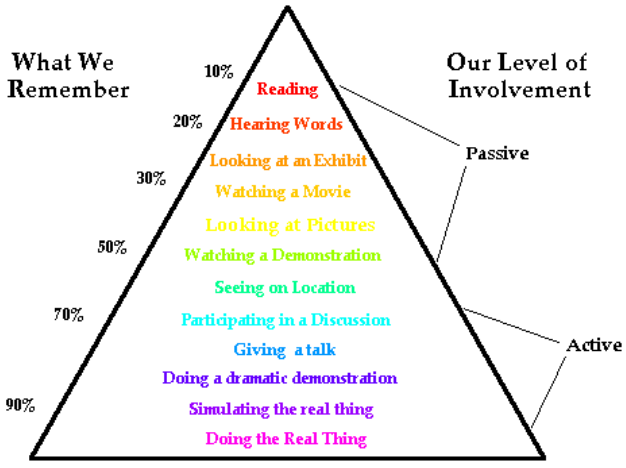
Optional Exercise: If participants appear to be acquiring rapid understanding of the concepts and principles presented, they might be up to a challenging exercise in which they create a diagram that demonstrates the relationships between the various elements that characterize Constructivist Learning. This exercise is explained in the exercise provided in **Handout 2b**. Pass out a large sheet of poster paper to each group for them to draw their diagrams. If participants seem capable of doing this exercise, provide about 30 minutes for them to 'construct' a diagram that explains the various elements of Constructivist Learning. Ask each group to present their diagrams and the reasoning behind them.

Why Constructivist Learning Is Effective

Pass out **Handout 3:** 'Why Constructivist Learning is Effective.' The facilitator should next explain how Constructivist Learning maximizes the effectiveness of the learning process by focusing on activities that are more active than passive. Point out how the degree of 'remembering' increases as one moves away from more passive activities to more active ones. This can be seen clearly in the diagram provided.

The facilitator should further explain that more passive activities such as reading also have a place in the learning process; however, these need to be reinforced through more active follow-up activities that exemplify Constructivist Learning principles where students are given the opportunity to be creative in formulating new concepts.

In their groups, ask participants to identify a reinforcing exercise that is both 'active' and which exemplifies the 'principles of Constructivist Learning.' Participants should be as explicit as possible about the reinforcing activity. Provide about 15 minutes for this exercise. Discuss the various reinforc-



ing activities that participants identified.

Lesson 3.2- Applications of Constructivist Learning in the Classroom

Lesson Time: 3 Hours and 30 Minutes

Trainer Preparation:

- Write up the Learning Outcomes of the lesson on a sheet of poster paper to introduce the lesson.
- Make copies of **Handout 4:** *Links between Constructivist Learning & Bloom's Taxonomy*
- Make copies of **Handout 5a:** *Concept Formation and Constructivist Learning*
- Make copies of **Handout 5b:** *Two Contrasting Concept Constructions*
- Make copies of **Handout 6:** *Some Useful Teaching Strategies for Constructivist Learning*
- Make copies of **Handout 7:** *Problem-based Learning Approaches to Promote Constructivist Learning*

Resources/Materials:

- Poster paper, marker pens
- Poster sheet summarizing the learning outcomes of the lesson.
- **Handout 4:** Links between Constructivist Learning & Bloom's Taxonomy
- **Handout 5a:** Concept Formation and Constructivist Learning
- **Handout 5b:** Two Contrasting Concept Constructions
- **Handout 6:** Some Useful Teaching Strategies for Constructivist Learning
- **Handout 7:** Problem-based Learning Approaches to Promote Constructivist Learning
- Some secondary school textbooks across a range of subjects (e.g., Chemistry, Physics, Biology, Math, Khmer Language, Social Studies)
- Blank Fact and Consequence Cards made out of colored construction cards that must be completed by participants based on a lesson from a textbook
- 3 or 4 Laminated Pictures of the scene from Ancient China shown in Handout 7.
- Poster Paper Sheets with a Key Principle written on it

Learning Outcomes:

- Participants can **explain** the links between Constructivist Learning and Bloom's Taxonomy in terms of the levels of thinking that it implies as well as developing appropriate questions that exemplify it.
- Participants can **explain** the steps in promoting Concept Formation and can **complete** an exercise that employs these steps.
- Participants can **distinguish** between the different techniques used for promoting Concept Formation including 'mind maps' and 'concept maps.'
- Participants can **answer** questions relating to the analysis of a 'concept construction' exercise undertaken by students.
- Participants can successfully **complete** an exercise that requires them to use some of the teaching techniques designed to promote Constructivist Learning with any given lesson to create an original exercise that follows the same format and principles.
- Participants **explain** how an actual exercise that they did for Problem-based Learning exemplifies some of the instructional principles described in the session.

Training Session Plan

Outcomes of the Lesson

Place a sheet of poster paper up on the board that summarizes the learning outcomes for the lesson. Explain the outcomes and that this is what the participants should be able to do at the completion of the lesson.

Links between Constructivist Learning and Bloom's Taxonomy

The facilitator should begin this discussion by highlighting an earlier mentioned key principle of Constructivist Learning relating to the strong focus on higher order thinking skills. If we relate this principle to Bloom's Taxonomy, we would conclude that Constructivist Learning mostly requires the top three thinking skills, namely **Analysis, Evaluation,** and **Synthesis.**

But before giving this answer, ask participants what the three top levels of Bloom's Taxonomy are.

Next, pass out **Handout 4:** 'Links between Constructivist Learning and Bloom's Taxonomy.' Review the levels of thinking of the taxonomy in case some individuals are not so familiar with it, pointing out that each level of thinking builds on and requires the skill levels below it. Most importantly, define the characteristics of Analysis, Evaluation, and Synthesis:

- **Analysis:** Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.
- **Evaluation:** Make judgments about the value of ideas or materials by creating assessment standards through which to make these judgments.
- **Synthesis:** Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.[1]

Continue to explain that Bloom's taxonomy can be useful to Constructivist Learning in two ways. **First,** it can help us to frame an activity at a specific level. Some examples are given in the first diagram of Handout 4. **Secondly,** it can help us frame questions that require problem-solving skills at a high level.

Review some of the examples of each of the activities and questions at different skill levels that are provided in Handout 4 and answer any questions that participants might have.

[1] http://www.nwlink.com/~donclark/hrd/bloom.html

When you have completed your explanation, ask participants in their groups to develop Constructivist Learning questions that exemplify the three skill levels in Bloom's Taxonomy by using the exercise provided at the bottom of the handout. Participants may choose questions from any subject with which they are comfortable. Provide about 15 minutes for this exercise.

When each group has finished, ask them to write their questions on the board and discuss them as a group, checking that the questions actually exemplify the skills called for in the definitions that were provided.

Concept Formation in a Constructivist Learning Classroom

Begin this session by reviewing some of the points raised in an earlier section, namely the central definition of Constructivism. Therefore, ask the question:

What is the essential element defining Constructivism?

The answer is: Providing the context where students can 'construct' new concepts using given data points as the building blocks for these concepts.

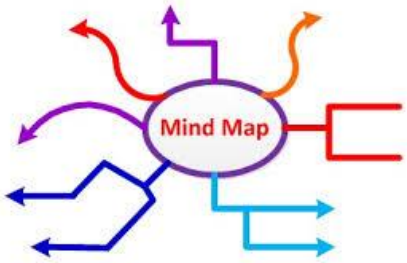
Pass out **Handout 5a:** 'Concept Formation and Constructivist Learning.' Next, lead a guided discussion with participants where you review the following through a question and answer approach:

- How many steps are there in organizing the concept formation process? (There are 4 steps described in the handout)
- What must students do in order combine data points? (e.g., analyze relationships between data points, classify data points in terms of commonalities, etc.)
- What critical thinking skills does the analysis of relationships remind you of? (e.g., analogies - looking for relationships; classification, etc.)
- What thinking levels in Bloom's Taxonomy do these steps remind you of? (e.g., analyzing relationships is clearly analysis, creating criteria to judge where different data points belong is Evaluation; combining data points to create new concepts and creating labels is clearly Synthesis, etc.).
- When students share their hypotheses, what Constructivist Learning Principle does this reflect? (e.g., Collaboration)
- What other teaching methodologies are implied in this process? (e.g., Cooperative Learning)

Once the facilitator has finished reviewing the steps in concept formation, move onto discussing the various vehicles that students can use to undertake concept formation (e.g., mind maps, concept maps, etc.) as well as the various benefits of Concept Formation. ***Be sure to note that the use of diagrams and pictures are often ideal tools for Concept Formation activities.***

Ask participants if they have ever heard of these techniques before. Provide clarifications as necessary, for example:

- **Mind Map:** a graphic technique for mapping and organizing concepts that uses distinct uses of imagery resembling tree branches, colors, and visual-spatial arrangements. The maps use keywords that trigger associations in the brain and spark further ideas.



- **Concept Maps:** a graphic technique that is similar to mind maps but which are more structured and detailed and may involve the use of phrases, arrows to indicate the flow and direction of ideas, etc.

Following this explanation, ask participants to work in their groups to complete the Concept Formation Exercise provided at the end of **Handout 5a.** Give about 15 minutes for this exercise and encourage participants to make fact checks online to add detail to their mind maps.

Review each mind/concept map together as a large group to contrast the possible differences for how each group conceptualized their understanding of the data points. The facilitator should note in this regard that there is no right or wrong way to conceptualize information and differences are usually acceptable as long as the classifications have been done correctly.

Next, pass out **Handout 5b:** Two Contrasting Concept Constructions.

Note that the diagrams shown in this handout are Concept Maps. The facilitator should explain that this handout provides another example of a Concept Formation exercise in a specific subject, namely History. Read through the Handout, noting that 'cause and effect' exercises are another very useful Concept Formation process.

Ask participants whether the diagrams shown are concept maps or mind maps? If they answer concept maps, ask them why they thought so? Possible answers should include the following:

- The diagrams are more structured
- The diagrams include phrases and sentences, not just single key words as in mind maps.
- The diagrams show directionality

Review the Questions for Discussion as a large group or in small groups if time permits. In the guided discussion that follows, be sure to note the following points:

- Both diagrams are correct but one group has mapped more concepts
- Both diagrams are logical but one group has prioritized causes using a different color

Useful Teaching Strategies Through Which to Implement Constructivist Learning: Cooperative Learning

Begin this session by referring back to the idea raised earlier that Constructivism is a very eclectic theory of learning that takes in several other methodologies such as **Cooperative Learning** and **Problem-based Learning.** For the present session, we would like to use some principles from these learning theories to promote Constructivist Learning.

Pass out **Handout 6:** Some Useful Teaching Strategies for Constructivist Learning.

Review the *General Guidelines* in the handout about some specific teaching approaches that are 'cooperative' in nature including (a) how to form working groups, (b) the tasks that should be carried out in these groups, (c) how to make learning materials that help to 'diagnose' understanding, and other techniques.

The facilitator should next explain that there are two suggested reinforcement exercises that exemplify Constructivist and Cooperative Learning Principles. The first of these is called **Decisions-Decisions** while the other is called **Jigsaw.** Provide an explanation of each game based on the description given in the handout. Together as a large group, go through the sample exercises provided, answering the questions provided as an example.

Next, pass out some textbooks according to the subject specializations of participants (chemistry, biology, math, history, etc.) and ask them to choose a lesson for which they could develop an exercise using one of the two techniques suggested above (i.e., Decisions-Decisions **or** Jigsaw). This is explained in the Exercise at the end of **Handout 6.** Also be sure to provide participants with some blank color cards (if they decide to do a Decisions-Decisions Exercise) and/or some poster paper if they decide to do a Jigsaw Exercise. Provide about 40 minutes for each group to come up with their exercise and about 20 minutes for groups to present what they have done. Participants may use the explanatory templates provided in the handout when developing their activities or come up with their own.

Discuss and critique the exercises that each group has developed. The facilitator should in particular check that exercises meet the following criteria:

- Follows the template explained for each activity
- Provides questions and exercises that are occurring at the level of Analysis, Evaluation, and/or Synthesis
- Directions for students are clear
- Etc.

Useful Teaching Strategies Through Which to Implement Constructivist

Learning: Problem-based Learning

This next session focuses on applying Problem-based Learning (PBL) to Constructivism. The Facilitator should explain that Constructivist Learning can also borrow many principles from Problem-based Learning that also leads to the formation of new concepts and skills. Write the following key principles for PBL on the board:

(a) Identifying what one already knows
(b) Identifying what one needs to know, and
(c) Knowing how and where to access new information that may lead to the resolution of the problem.

Continue to explain that when we solve problems, we need to **analyze** the context and our own knowledge, determine what one needs to know (**evaluate**), and then create a solution (**synthesis**).

Introduce an example by passing out some laminated pictures of Ancient China.

Explain that the illustration shows a picture of life in Ancient China with some historical inaccuracies (Problem). Students need to find the historical inaccuracies in the picture and explain why they are wrong (Solution).

Ask participants to take about 15 minutes to find the inaccuracies in the picture and then quickly explain why they are wrong. Use a tablet or laptop to go online to research your analysis, as noted in the example provided. Use the table template below to solve the problem given.

Inaccuracy in Picture	Explanation
(a) Example: The ancient Chinese would not have had a modern wheelbarrow.	Although the Chinese invented a device that was a precursor of the wheelbarrow called a 'wooden ox', shown here in this picture, they would not have had its modern equivalent. The wooden ox had a wheel at its center while a modern wheelbarrow has its center of gravity closer to the far end of the
(b)	
(c)	

(d)

(e)

(f)

(g)

When participants have completed the exercise, go over the answers quickly together by reviewing the explanations provided in **Handout 7.**

Next, the facilitator should ask participants to review the Discussion Questions in **Handout 7** and brainstorm some answers to each question. When they are done, try to list some responses on the board as a large group. Use some of the bullet points below to help guide your discussion:

1. *How many errors were you able to find?*
   - 7 things in the picture were not correct and we found all of them.
2. *How did your group identify what it already knew about the problem? (For example, the time period when the wall was built, the technology available at that time, etc.).*
   - We knew that the picture was set at around the time of the construction of the Great Wall of China
   - The Great Wall of China was built around 200 BC over a period of many centuries
   - Technology at this time would have been very primitive and contacts with Europe very difficult
3. *How did you identify what you needed to know to solve the problem? (For example, what things were you not sure about in the picture that you needed to investigate?)*
   - We needed to know when the modern wheelbarrow was invented
   - We needed to know when the Eiffel Tower was built
   - We needed to know what Chinese money looked like in ancient times
   - We needed to know when railroads came into use
   - We needed to know when England became a country would the symbol of Christianity (the cross) be seen on a flag before the Christian Era
   - Etc.
4. *How did you identify what you did not yet know to solve the problem at hand?*
   - Check on online using Google search engines

Lesson 3.3- Creating the Institutional Context to Promote Constructivist Learning

Lesson Time: 90 Minutes

Trainer Preparation:

- Write up the Learning Outcomes of the lesson on a sheet of poster paper to introduce the lesson.
- Make copies of **Handout 8:** *Constructivist Learning Processes & Products*
- Make copies of **Handout 9:** *Constructivism & Technology*

Resources/Materials:

- Poster paper, marker pens
- Poster sheet summarizing the learning outcomes of the lesson.
- **Handout 8:** *Constructivist Learning Processes & Products* **Handout 5a:** Concept Formation and Constructivist Learning
- **Handout 9:** *Constructivism & Technology*

Learning Outcomes:

- Participants can **identify** specific instructional techniques (e.g., group work, lab tasks, field trips, etc.) that exemplify Constructivist Learning.
- Participants can **determine** whether these Constructivist activities are processes or products.
- Participants can **determine** how specific instructional techniques exemplify key principles of Constructivist Learning.
- Participants can **identify** the needed institutional conditions needed to effectively implement instructional techniques that promote Constructivist Learning.

Training Session Plan

Outcomes of the Lesson

Place a sheet of poster paper up on the board that summarizes the learning outcomes for the lesson. Explain the outcomes and that this is what the participants should be able to do at the completion of the lesson.

Constructivist Processes and Products

The facilitator should begin this session by explaining that Constructivist Learning promotes the creation of learning processes and products. These can take many forms.

Try to brainstorm a list with participants on the blackboard. Remind participants that these activities should exemplify higher order thinking skills. Give a few examples like Presentations, Exhibitions, etc. to give participants some idea of the kinds of activities they should be brainstorming about.

Next, pass out **Handout 8:** 'Constructivist Learning Processes and Products.' Compare the list on the board with those in the handout.

Discuss whether there are any activities that don't belong? Activities that should be added, etc. Review those activities that are in the Handout, particularly those that may not have shown up in the brainstorm list.

Following this discussion, ask participants to pick an activity from the list and do the exercise indicated in **Handout 8.** Each group need only pick 'one' activity. Give groups about 10 to 12 minutes for this activity. When they are done, lead a guided discussion about the answers provided by each group. Some examples are provided for the facilitator to help guide the discussion and review the responses provided.

Constructivist Activity	Product or Process?	How It Exemplifies a Given Principle
Science Projects (Example)	Process (unless there is a tangible outcome like a booklet, model, etc)	Interactive because students do them as a group Facilitates learning because students can learn in an unstructured environment where they can ask questions among themselves and with the teacher freely Authentic if it addresses real life problems like water pollution, dangers of mixing coca cola and menthos, dietary issues, etc. Learner centered because it enable students set the parameters of what they do for the project and how they do it Involves Higher-order thinking because students must analyze the science topic issue

		and make conclusions (evaluation)
Group Work Projects	Both a process and product	
Exhibitions	Product	
Presentations	Process	
Book Reports & Anthologies	Products	
On-line Research	Process	
Field Trips	Process	
Science Lab Task-work	Process Product	

The facilitator should next explain that organizing the constructivist activities in a school and classroom could be a challenge if there are no institutional provisions in place to ensure that they can be done effectively. For example, consider some of the following questions:

- Do schools have subject clubs where extracurricular activities such as Science, History, and other projects can be carried out?
- Do the clubs have budgets?
- Does the school have a science lab where lab work can be carried out? Does the lab have materials?
- Do classrooms have bulletin boards or cabinets where exhibitions can be displayed?
- Does the school have provisions in place for field trips where parents must sign forms allowing their children to participate, etc.?

Draw the table at the bottom of **Handout 8** (p 2) on the board and complete it as a large group, identifying as many institutional requirements as possible to facilitate the successful implementation of each activity indicated.

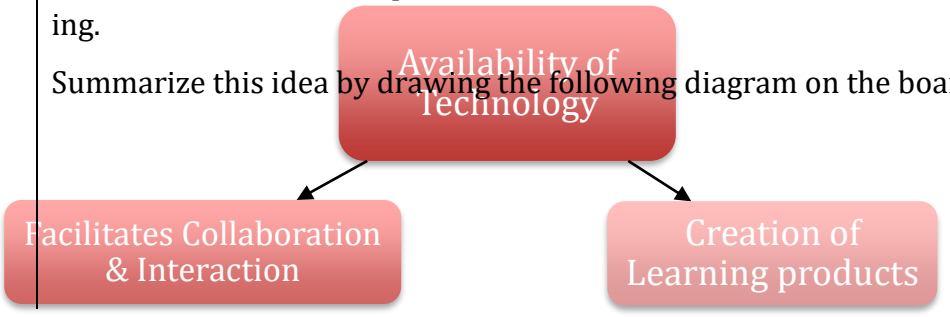
Constructivist Learning Activity	Institutional Requirements
Science Projects	Provisions for a science teacher who volunteers to advise a science club Budget for materials Enough time: Either extracurricular or an extended school day

	Access to a Club Training Manual
Group Work Projects	Seating arrangements in classrooms should facilitate group work Online research facilities Enough time: Either extracurricular or an extended school day Stationery materials for study, reporting, etc.
Exhibitions	Bulletin boards in classrooms and hallways for displaying exhibitions Availability of display cabinets Budget for needed materials Parents' night ceremony provisions Online research facilities and printing
Presentations	Access to LCD Projectors Available time either in the official schedule (e.g., under a New Generation School regime) or extracurricular time Online research facilities (e.g., in library, computer lab, etc.) Access to Presentation software such as PowerPoint
Book Reports & Anthologies	Online research facilities (e.g., in library, computer lab, etc.) Access to clubs Availability of printing facilities and budget
On-line Research	Online research facilities (e.g., in library, computer lab, etc.) Internet access
Field Trips	Written protocols for organizing students (e.g., number of students per supervising teacher, forms to ask for parental permission, etc.) Budget for travel, admission fees, etc.
Science Lab Task Work	Access to science lab facilities Availability of lab materials Available time either in the official schedule (e.g., under a New Generation School regime) or extracurricular time

Constructivism and Technology

Start this final session with the explanation that Technology is an ideal tool to facilitate the construction of 'learning products' such as reports, PowerPoint Presentations. Anthologies, etc. Networking and sharing similarly provide enhanced opportunities for students to collaborate together, share ideas, etc. The availability of technology in a school is, therefore, an essential institutional requirement that can facilitate Constructivist Learning.

Summarize this idea by drawing the following diagram on the board:



Pass out **Handout 9:** Constructivism & Technology.

Review some of the ways that Technology can promote creating learning products and collaboration. Write these under the two bottom boxes of the diagram that you drew on the board according to what they promote most. For example, Telecommunication tools clearly promote 'collaboration and interaction.'

- ***Telecommunication tools*** such as e-mail and the Internet provide a means for dialogue, discussion, and debate -- interactivity that leads to the social construction of meaning
- ***PowerPoint Presentations:*** Presentations developed by students in their groups also provide a useful social channel for students to work together in teams to produce a creative product to share with the class. Schools should make LCD projectors available to both teachers and students for this purpose.
- ***Online Workstations in the Library:*** Creating easily accessible workstations in the library is another means through which students can work together on analytical tasks. The workstations may be used to solve problems assigned by the teacher, the development of Project Work, and a source of useful pictures and diagrams.
- ***Networked writing programs*** provide a unique platform for collaborative writing. Students can write for real audiences who respond instantly and who participate in a collective writing activity.

Brainstorm other mechanisms through which technology can promote collaboration and the creation of learning products and add these to your list that you already wrote on the board.

Lesson 3.4- Evaluating Students in a Constructivist Learning Classroom

Lesson Time: 2 Hours

Trainer Preparation:

- Write up the Learning Outcomes of the lesson on a sheet of poster paper to introduce the lesson.
- Make copies of **Handout 10:** *Contrasting Evaluation of Traditional Learning and Constructivist Learning*
- Make copies of **Handout 11:** *Evaluation Strategies in a Constructivist Learning Environment*
- Make copies of **Handout 12:** *Concrete Examples of Evaluation Strategies Used to Assess Constructivist Learning*

Resources/Materials:

- Poster paper, marker pens
- Poster sheet summarizing the learning outcomes of the lesson.
- **Handout 10:** Contrasting Evaluation of Traditional Learning and Constructivist Learning
- **Handout 11:** Evaluation Strategies in a Constructivist Learning Environment
- **Handout 12:** Concrete Examples of Evaluation Strategies Used to Assess Constructivist Learning

Learning Outcomes:

- Participants can **explain** why Constructivist Learning requires special strategies for evaluating students' learning.
- Participants can **identify** some key strategies for evaluating learning in a Constructivist Learning environment.
- Participants can **describe** some of the key characteristics of each evaluation strategy used to assess Constructivist Learning.
- Participants can effectively **compare and contrast** the characteristics of different evaluation strategies used to assess Constructivist

Learning using a special table designed for the purpose.

Training Session Plan

Outcomes of the Lesson

Place a sheet of poster paper up on the board that summarizes the learning outcomes for the lesson. Explain the outcomes and that this is what the participants should be able to do at the completion of the lesson.

Constructivist Processes and Products

The facilitator should begin this session by explaining that traditional evaluation strategies (e.g., tests, quizzes, etc.) do not lend themselves well to assessing Constructivist Learning because the teacher needs to know about the internal process of thinking used by the student to create learning products. That is, understanding how students come to a solution or conclusion about something is as important as the product or solution itself.

After starting with this explanation, pass out **Handout 10** to help participants understand the contrast between Traditional and Constructivist Learning and the implications.

Next, organize a small group discussion in which participants examine the cartoons provided in the handout and answer the questions provided at the bottom of the page. Provide about 15 minutes for this small group discussion. Then, review the answers of each group in a large group to ensure that they understand how learning is different in the two contexts and how this would affect student assessment. Use the suggested responses provided below to help guide the large group discussion:

Discussion Questions

1. **What levels of thinking are implied in the evaluation implied in Picture A? in Picture B? Use Bloom's Taxonomy to frame your answers.**
    a. *Picrture A: Memory, Understanding (perhaps Application)*
    b. *Picture B: Application, Analysis, Synthesis, Evaluation*
2. **List the advantages and disadvantages of the evaluation strategies implied in both Picture A and Picture B.**
    a. *Picture A Advantages:*
        i. *Easy to evaluate students through simple tests and quizzes*
        ii. *Requires evaluation that fits well into the traditional assessemnt frameworks of most schools*
    b. *Picture A: Disadvantages*
        i. *Students are not challenged by learning tasks*
        ii. *Learning occurs at a very shallow level*
        iii. *Students have little opportunity to think critically or be creative.*
    c. *Picture B Advantages:*
        i. *Students are challenged by learning tasks*
        ii. *Learning tasks encourage higher order thinking skills*

iii. *Teachers develop a good understanding of how children think and where they may be experiencing challenges*

d. *Picture B: Disadvantages*
   i. *Implied assessment methods are very time intensive*
   ii. *Requires new methods of student assessment that many teachers may not be familiar with*
   iii. *Does not fit well with traditional assessment framewrorks used in most schools*

3. **Why do you think teachers in Cambodia do not often use the learning and evaluation strategies implied in Picture B?**
   a. *Most teachers simply focus on teaching to traditional test formats, which do not foster critical thinking.*
   b. *Most teachers are not aware of either Constructivist Learning philosophies or the evaluation strategies that they imply.*
   c. *Many teachers have other priorities outside of the classroom and do not have the time to use more time-intensive teaching and assessment techniques.*
   d. *Other?*

After the above discussion is completed, pass out **Handout 11** to review some of the specific evaluation strategies used by educators to assess students' learning in a Constructivist Learning environment. These strategies include the following:

- Dynamic Assessment
- Portfolio Assessment
- Process-oriented Assessment
- Informal Assessment

Review some of the key characteristics of these assessment strategies with participants using the handout provided. During this review, be sure to note some of the following points:

- These strategies require a high level of interaction with individual students and the groups that they work in.
- These interactions often take the form of interviews, informal discussions, and observations of student behaviors among others.
- There is as much focus on the process of learning as the actual products and solutions that may result during the completion of a learning task.
- There is often a great deal of overlap between these different strategies in terms of their characteristics.
- These strategies can also complement the more formalized evaluation frameworks with the information that they generate about students' learning.

Next, the facilitator should give further explanation of the discussion above by providing some concrete examples of the evaluation strategies identified in Handout 11. For this purpose, pass out **Handout 12** and review each example provided as a means to exemplify the explanations provided earlier.

Following these explanations, ask participants to complete the small group exercise provided at the end of Handout 12. Give about 20 minutes for this exercise so that participants can complete the table provided. Pass out poster paper for groups to document their answers.

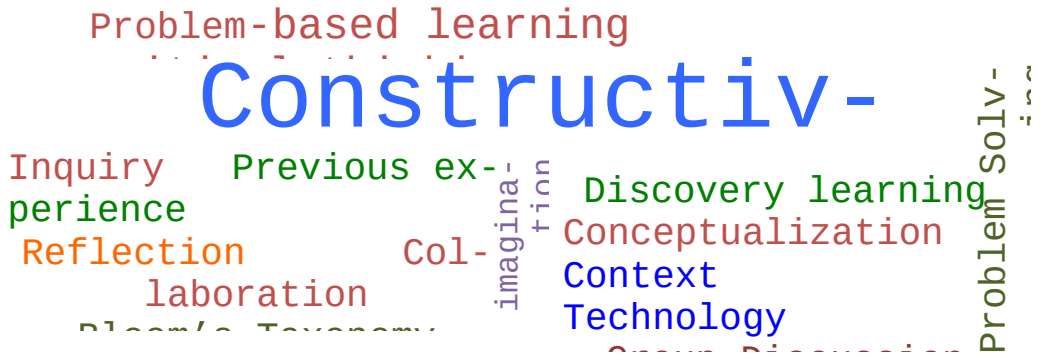
When groups have completed their tables, ask them to put them on the wall to compare answers. Use the notional answers provided below as a tool to guide your subsequent discussion to reconcile answers and further participants grasp of key concepts.

Factor	Dynamic Assessment	Portfolio Review	Process-oriented	Informal Assessment
Timing (e.g., before, during, end of task)	Continuous	Terminal	Continu-ous	Continuous
Product Focus (e.g., high, low, etc.)	Moderate	High	Low	Moderate
Process Focus (e.g., high, low, etc.)	High	Moderate	High	High
Teacher Interaction (e.g., high, low, etc.)	High	Moderate	High	High
Use of Formal Assess-ment Techniques (e.g., checklists, tests, etc.)	Moderate	High	Moderate	Low

Participant Course Materials

HANDOUT 1: Links between Constructivism and Other Learning Theories

- Constructivism is a very broad theory that takes in many related concepts.
- While the central feature of the approach is all about the ability of students to **manipulate concepts,** there are many related elements of the approach that include critical thinking, problem-solving, the need for collaborative learning, and intensive use of technology amongst many others.



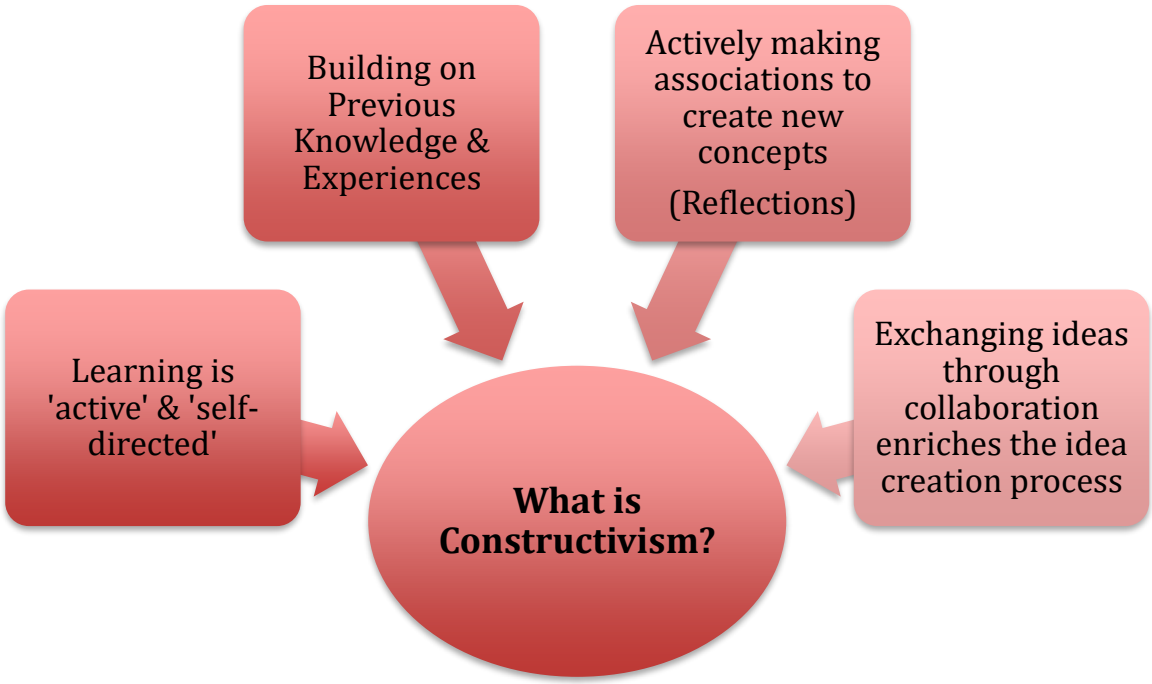
Questions for Discussion

- How many of these learning theories have you heard of before? Based on what you know so far, can you explain how they might relate to Constructivism?
- Why do you think that 'collaboration' is essential for constructing new concepts and ideas?
- What do you think is the relationship between Bloom's Taxonomy and Constructivism?
- How do you think that technology can promote Constructivism?

HANDOUT 2a: Defining Constructivist Learning

Definition

Constructivism is the view that students collaboratively **con-struct** their knowledge from individual experiences and from thinking through these experiences (Reflection). The constructivist model of learning argues that the learner should have more control (i.e., be self-directed) over the learning process than the 'traditional lecture based classrooms' and that individuals learn better when they discover things on their own.[2]



The diagram above gives more concrete meaning to the above definitions. According to the diagram, if you are:

- Engaging actively in a task you chose to do (self-directed)
- Reflecting on new information and previous experiences
- Adding in new ideas based on collaboration with peers
- And . . .forming new concepts based on your reflections

THEN, you are learning in a 'constructivist' manner!

[2] https://bc.instructure.com/courses/829527/pages/theory-constructivist-learning

Exercise

Directions: An analogy is a comparison of two pairs of words that demonstrate a similar relationship. Look at the example below.

Example 1: Father is to Son (1st Pair) as Mother is to Daughter (2nd Pair)
What is the relationship? A child of the same sex as the parent

Example 2: Wing is to a Plane as a Sail is to a Boat
What is the relationship? Helps to propel something

Using the examples provided above, try in your groups to construct four more analogies that show a similar relationship.

Analogy 1: _____ *is to* _____ *as* _____ *is to* _____
Analogy 2: _____ *is to* _____ *as* _____ *is to* _____
Analogy 3: _____ *is to* _____ *as* _____ *is to* _____
Analogy 4: _____ *is to* _____ *as* _____ *is to* _____

When you are done, share the analogies that you constructed with the large group.

Next, describe how this process reflects Constructivist Learning by responding to the questions below:

What did you do in this exercise that reflects the different components of Constructivist Learning?

1. Self-directed Activity:
   _____
2. Reflecting on Past Experience and New Information:
   _____
3. Collaborating with Others to Increase Idea Diversity:
   _____
4. Creating New Knowledge & Concepts:
   _____

HANDOUT 2b: Key Principles in Constructivist Learning

Here are some other Key Guiding Principles about Implementing Constructivist Learning in the Classroom:

- **Interactive learning** – people naturally learn and work collaboratively in their lives. Interactivity provides a way to motivate and stimulate learners. It offers a way through activities and discussions for teachers to cause learners to consider and reflect on the content and process of learning. Interactions between instructors, other learners, and content are crucial functions in Constructivist Learning.

  Examples: Students work in classroom groups, group projects, online networks, subject clubs, field interviews to collect information for a project, etc.

- **Facilitating learning** – create a safe environment for learners to express themselves freely in appropriate ways, to share ideas, and to ask questions. Instructors in constructivist learning environments have a responsibility to monitor and warrant the quality of learning and peer discussions. It is necessary for the instructor to build sufficient support, directions and guidelines for online learners.

  Examples: Teachers act as 'Learning Facilitators,' not Lecturers, Teachers work as advisers to student-led subject clubs, etc.

- **Authentic learning** – Constructivist learning stresses that learning should be authentic and meet real life experiences. The learning environment should provide real-world, case-based environments for meaningful and authentic knowledge.

  Examples: Field trips to historical sites, museums, factories, etc; Science lab experiments led by students, etc.

- **Learner-centered learning** – Self-directed learners are usually highly motivated, know what they want to learn, set their objectives, find resources, and evaluate their learning progress to meet their goals.

  Examples: Students choose the topics they want to study; students can declare majors in Chemistry, Physics, and other subjects of inter-

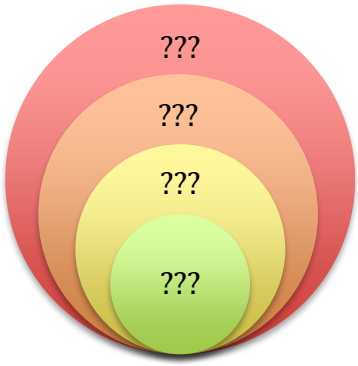
est; Students choose to join the Subject Clubs that most interest them; Project Work Groups choose their own topics for research, etc.

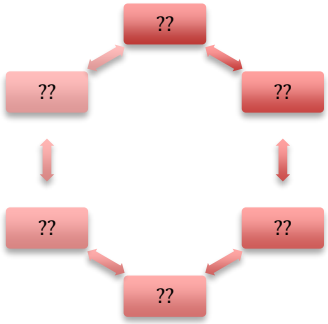
- **High quality learning** – Constructivist Learning should involve higher-order thinking skills in which students are synthesizing and evaluating information. Learners must learn how to manage, analyze, critique, cross-reference, and transform information into valuable knowledge.

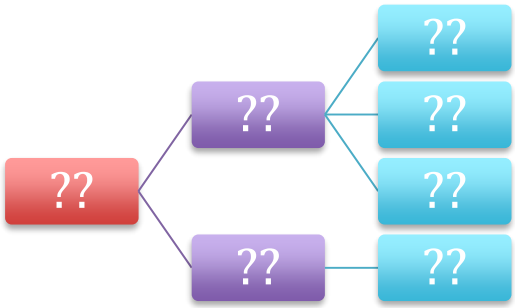
  Examples: Students develop their own PowerPoint Presentations that are logical and coherent; Students create their own poems, stories, and other creative writing; Students write book reports in which they analyze the meaning of a story that they have read, etc.

EXERCISE:

Directions: Constructivist Learning is all about forming new concepts and ideas through reflection on **New Knowledge** and one's **Previous Experience.** Collaborate with your group to create a diagram that expresses your understanding of the different concepts that define Constructivism and their relationships. There are many different kinds of diagrams that you can use for this exercise. Some diagrammatic examples are provided for you below. There is no single correct way to demonstrate your understanding and different groups may develop different diagrams to show differing interpretations.

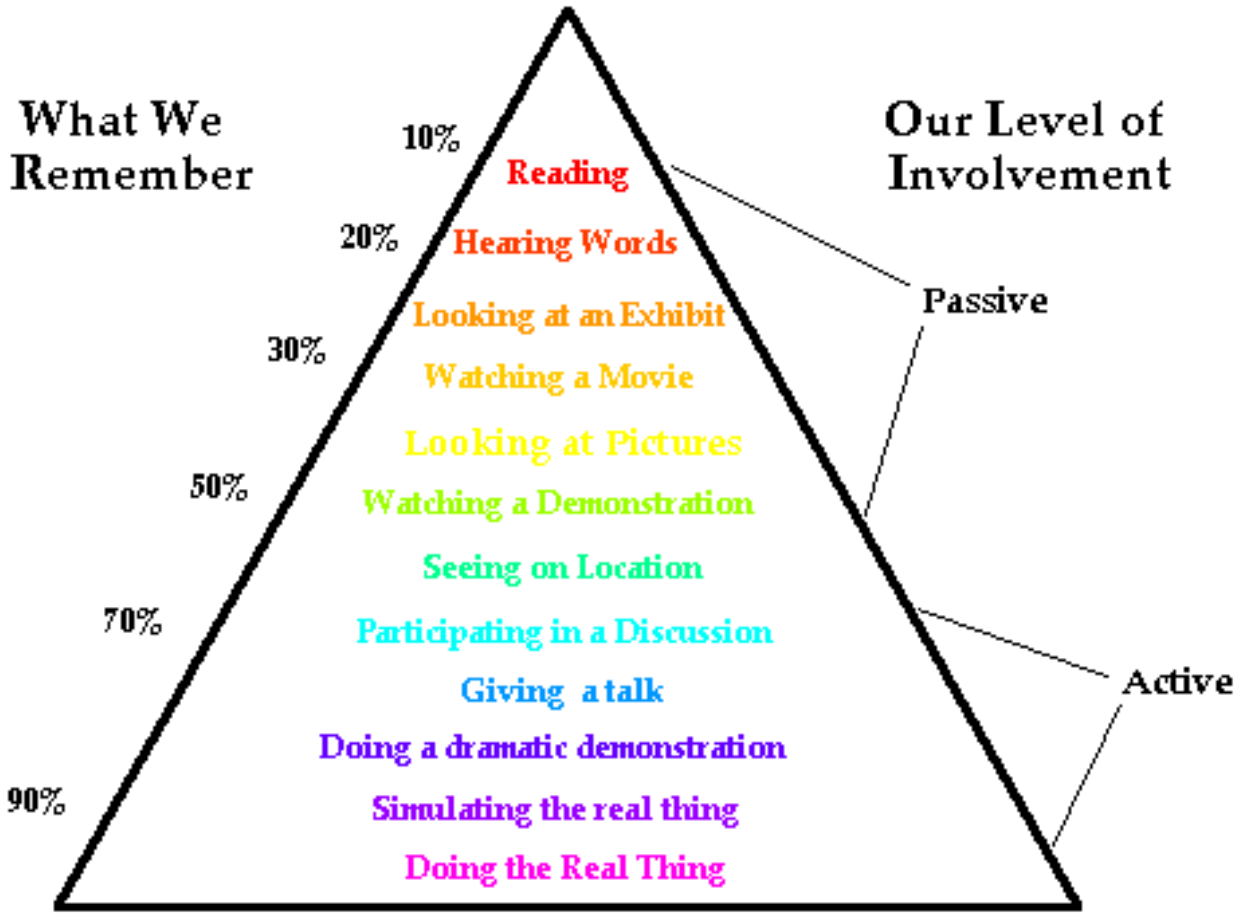






HANDOUT 3: Why Constructivist Learning Is Effective

- The diagram below indicates how our **Level of Involvement** in a learning task affects **how much we remember** from the task.
- The learning tasks at the **bottom** of the pyramid enable us to remember 50% or more of what we learn while those at the **top** of the pyramid enable less than 50% recall.
- One should NOT misunderstand that this diagram indicates that teachers should avoid asking students to do 'reading' or 'listen' to lectures. Rather, the diagram tries to explain that these tasks should be paired with other more active tasks to reinforce them.
- Using the diagram provided, try to complete the tasks provided in the Exercise below:

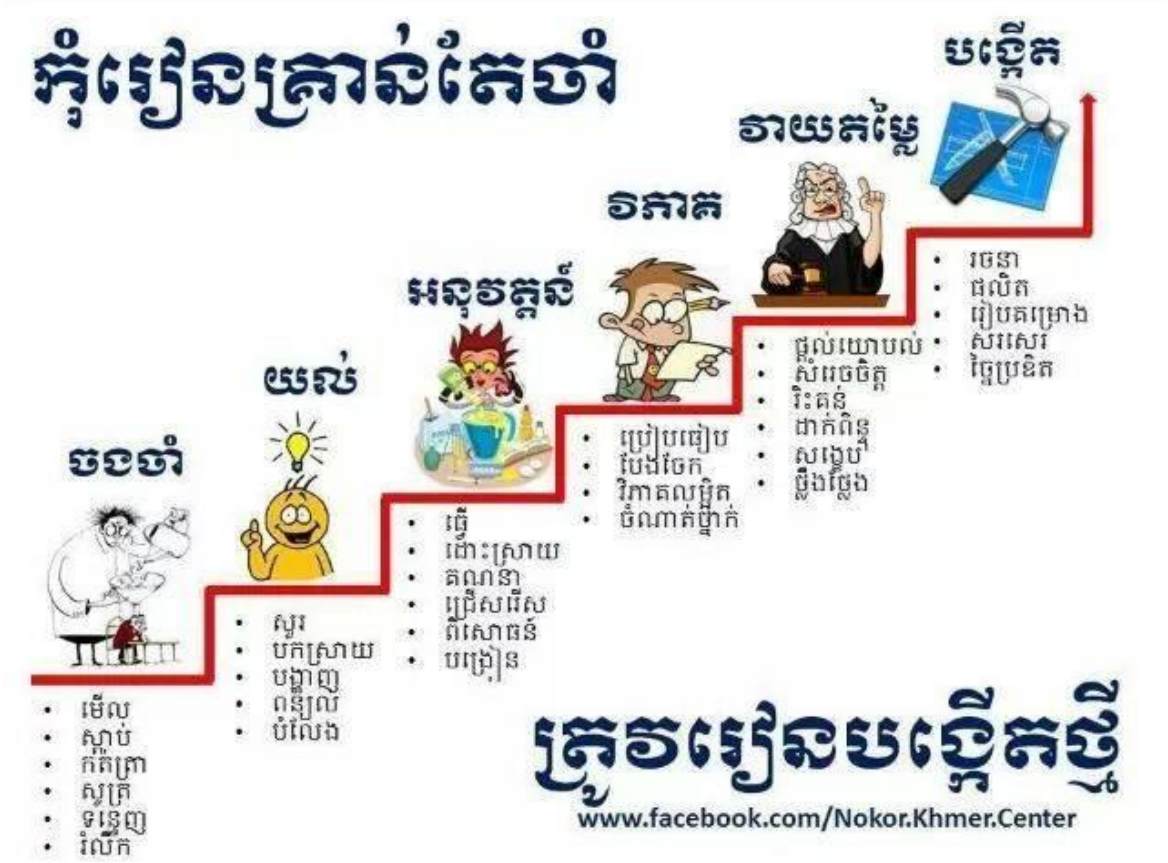


EXERCISE

Directions: *Try to complete the tasks below by identifying a more 'active' task to reinforce the 'passive' one. The passive tasks are already provided for you below. An example is also done for you.*

	Passive Task	Active Task (Reinforcement)
Ex.	**Task 1:** Reading a book about the history of Angkor	**Task 2:** Give a talk to the class about the book you read about Angkor
1.	**Task 1:** Listening to a lecture about electrolysis	**Task 2:** ???
2.	**Task 1:** Watching a documentary about how the heart works.	**Task 2:** ???
3.	**Task 1:** Watching a video about making Khmer Desserts	**Task 2:** ???
4.	**Task 1:** Listening to a lecture about the dangers of abusing drugs	**Task 2:** ???
5.	**Task 1:** Observing an exhibition about how rubber is processed in a factory	**Task 2:** ???

HANDOUT 4: Links between Constructivist Learning and Bloom's Taxonomy



DISCUSSION

Constructivist Learning tasks usually happen at the higher end of BLOOM'S TAXONOMY.

Analysis	Online research	Frog Disssection Experiment	Diagramming Historical Causality	Group Work Discussion
Evaluation	Doing an evaluative book report	Identifyng and applying standards	Prioritizing a List of things	Crtiquing an historical monument
Creating	Making an Anthology of Poems	Making an exhibition	Making a presentation	Predicting Consequences

Constructivist Learning tasks at this level of complexity often require long-term planning and multiple meetings, discussions, and revisions of a given product.

- Higher order questioning requires students to construct their own conceptions of the new material. One cannot reason with material until you have conceptualized it, so questions that require reasoning force conceptualization.

- Here are some guidelines to ask questions that foster Constructivist Learning:

Analyzing	
' How & Why' Questions	*-Why is our climate changing?* *-How are dengue and malaria alike? different?*

Evaluating	
'Judgment' Questions	*-Who was the greatest historical figure in Cambodian history?*

Creating	
'What if. . .' Questions	*-What if Jayvaraman VII had died when he was a child? What effect on Cambodian history would this have had?*

EXERCISE

Directions: Formulate one question for a subject of your choosing that would foster Constructivist Learning for each thinking category listed below:

Subject: _____	**Subject:** _____	**Subject:** _____
Analyzing	Evaluating	Creating
_____	_____	_____
_____	_____	_____

_____?	_____?	_____?

HANDOUT 5a: Concept Formation[3] and Constructivist Learning

Introduction: Constructivist Learning focuses on creating the conditions where students can form concepts by combining data and information into new and interesting forms.

Concept Formation Definition: Concept Formation is a process that encourages students to organize information by having them group items, words, pictures, formulas, or processes into categories based on common characteristics.

Common Steps in Concept Formation

Step 1: Teacher presents a set of data **or** has students help to generate a set of data

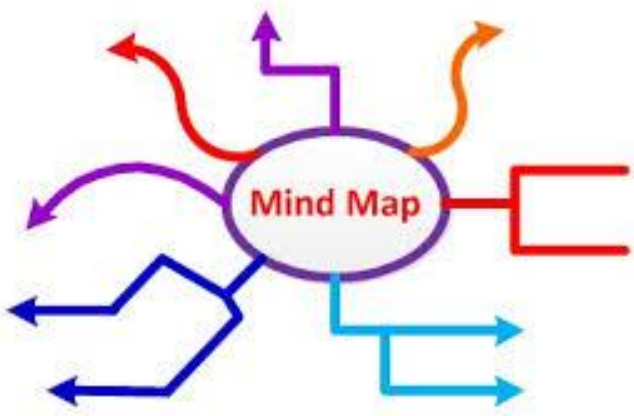
Step 2: Students group the data into categories by identifying common properties and deciding what belongs together and what criteria allows them to be together.

Step 3: Through questions and discussion, students identify labels for the categories

Step 4: Students share their hypotheses about their categories as well as how they came up with their categories.

Classroom Management Considerations

- Working in groups
- Data sets may be pre-made (by the teacher) or generated by the class
- Useful vehicles of expression include 'mind maps,' 'concept maps,' diagrams and flow charts, etc.



[3] http://www.tvdsb.ca/webpages/tkernaghan/educatorresources.cfm?subpage=190909

Key Benefits

- Gives students experience in identifying critical relationships when grouping data
- Helps students to make sense of information
- Facilitates remembering information when it is in pictoral form, especially for Visual Thinkers.

EXERCISE

Make a *mind map* that organizes the different languages of Cambodia. Use different colors to help distinguish between the different language groups. You might also try to classify languages by whether they are tonal, use Latin script, etc. Check for this and other information online.

Pre-made Data Points

Austroasiatic	Austronesian	Sino-Tibetan	Tai-Kadai	Indo-European
Khmer	Malay	Chinese	Thai	English
Mon	Cham	Vietnamese	Lao	French
Phnong		Burmese	Isan	Bali
Tampuan				
Kreung				
Kuy				
Stieng				

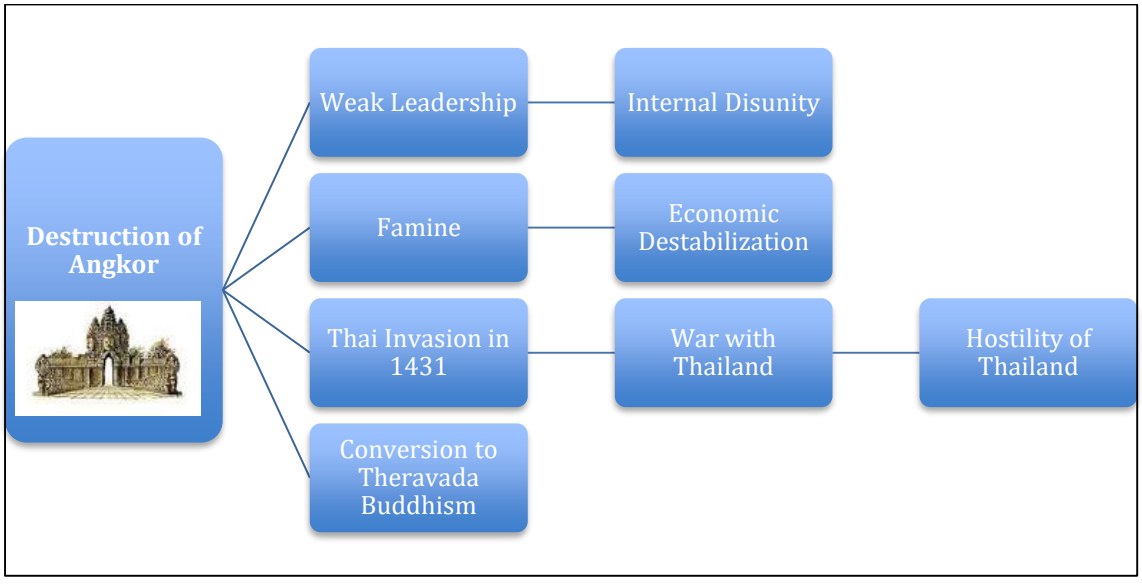
HANDOUT 5b: Two Contrasting Concept Constructions

Research Question: *What Caused the Destruction of the Khmer Empire at Angkor?*

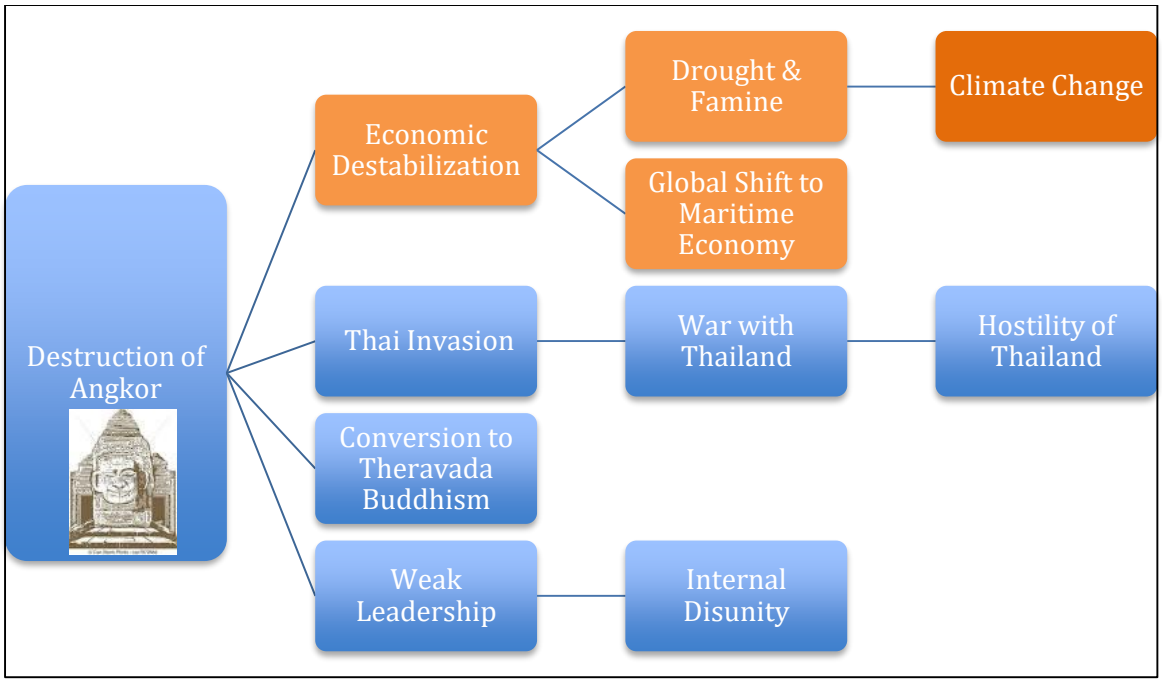
- **Background:** There are many competing theories about why the Angkorian Empire fell in the 15th Century. The most immediate cause was the Thai invasion in the year AD 1431 that resulted in wide scale destruction of the capital city Angkor and the decision to eventually abandon the capital for a new site near present day Phnom Penh.
- **Task:** Do some research on the causes of the destruction of Angkor and create a mapping of factors (causes and effects) that best explain how these factors were related and how they contributed to the fall of Angkor.
- **Possible Data Points to Consider**

War	Hostility of Thailand
Invasion	Global Shifts to Maritime Economy
Poor Leadership	Famine
Climate Change	Economic destabilization
Drought	Internal Disunity
Conversion to Theravada Buddhism	

Concept Construction by Group 1



Concept Construction by Group 2



QUESTIONS FOR DISCUSSION

1. How are the concept maps alike?
2. How do the concept maps done by each group differ? (e.g., which group has mapped more concepts?, do both maps seem logical in terms of the relationship between concepts?, Etc.)
3. What do you think the students that used different colors in their map want to say?
4. Is it possible to say that either or both of these concept maps are right or wrong? Why or why not?

HANDOUT 6: Some Useful Teaching Strategies for Constructivist Learning[4]

General Guidelines:

- Use teaching strategies that require students to make a construct or concept. (Presenting information is not enough.) Students must apply, use, or process the information.
- Ensure that all students are participating in making constructs; holding them accountable for their learning.
- Ensure the tasks require students to process the information at a high level on Bloom's taxonomy: Evaluation, synthesis, analysis etc.
- Require the students to make a product that is used to diagnose learning errors and omissions. e.g. speaking to a partner, matching cards, written work etc.
- Require students to check for their own, and each other's learning errors and omissions.
- Require students to correct these learning errors and omissions.

Some Techniques to Achieve the Above Strategies

Decisions-Decisions

Students, working in pairs, are given a text, video, etc, along with:

Summary Fact Cards which purport to summarize key points from the text, some of which are true and some of which are false: e.g.

- The term 'valence' refers to bonding between atoms
- Valence is usually defined in terms of the minimum number of hydrogen atoms that an element can bond with.

Consequence Cards which state consequences of the facts given in the text. These consequences are not actually stated in the text itself. Again some are true and some false.

E.g. What would happen if you substituted an oxygen atom for a sulfur atom in H_2S?

The pairs of students must decide which cards are correct, and what is wrong with the incorrect ones.

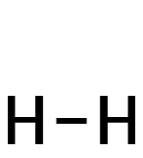
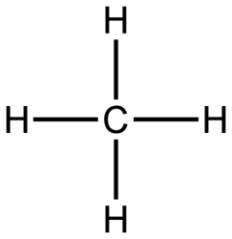
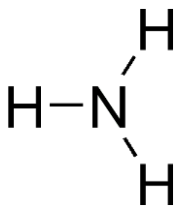
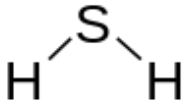
Here is an example of a ***Decisions-Decisions Exercise*** for a Chemistry

[4] http://www.teacherstoolbox.co.uk/25_Ways/25ways-15-decisions2.html

Lesson on Valence:

TEXT[5]

In chemistry, the **valence** of an element is made of its combining power with other atoms when it forms chemical compounds or molecules. The concept of valence was developed in the second half of the 19th century and was successful in explaining the molecular structure of inorganic and organic compounds. The combining power of an atom of an element was determined by the number of hydrogen atoms that it combined with. In **methane,** carbon has a valence of 4; in **ammonia,** nitrogen has a valence of 3; in **hydrogen sulfide,** sulfur has a valence of 2. Valence diagrams of a compound represent the connectivity of the elements, with lines drawn between two elements, sometimes called bonds, representing a saturated valency for each element. Here are some examples:

Compound	H_2 (Hydrogen)	CH_4 (Methane)	NH_3 (Ammonia)	H_2S (Hydrogen Sulfide)
Diagram				
Valencies	Hydrogen 1	Carbon, 4 Hydrogen, 1	Nitrogen, 3 Hydrogen, 1	Sulfur, 2 Hydrogen, 1

Directions: In your groups, determine which **Summary Fact Cards** are wrong and why they are wrong, based on your understanding of the text above. Then, predict the outcomes of the conditions described in the **Consequence Cards.**

SUMMARY FACT Cards	CONSEQUENCE Cards
1. The concept of valence has been successful in explaining the molecular structure of organic compounds.	A. What would happen if you substituted an oxygen atom for a sulfur atom in H_2S?
2. The term valence refers to bonding between atoms	B. What would happen to a methane molecule if you removed the carbon atom?
3. Valence is usually defined in terms of the minimum number hydrogen atoms that an element can bond with.	C. What would happen to the stability of an NH_3 Molecule if you removed one hydrogen atom?
4. Valence is a relatively recent concept.	D. Are there any other atoms that could be substituted for sulfur in H_2S? What would this produce?

[5] https://en.wikipedia.org/wiki/Valence_(chemistry)

Jigsaw: A Cooperative learning method

Jigsaw is one of many cooperative learning methods with high impact.

- Divide a topic up into four sub-topics. The number can be more or less than this, depending on your class size. For example different tropical diseases could be divided into (a) dysentery, (b) dengue, (c) malaria, and (d) typhoid.
- Alternatively, students can be given four different key questions or 'perspectives' that require students to analyze the same materials from a different point of view. For example, all students are given the same information about the French Colonial Period but then asked to assess the period's merits from the perspective of different groups: (a) Cambodian farmer; (b) Cambodian Administrator; (c) French Administrator; and (d) the King of Cambodia. This could prove to be an interesting Evaluation Level question because students must develop different standards of judgment used by each group and apply them to what the French did during the colonial period.

- Divide students into four groups. The teacher chooses the groups and they should be mixed ability, experience, ethnicity gender etc. Don't use friendship groups. Students may complain at first but will soon accept it if you are insistent.
- Each group studies one disease or question with the help of texts and worksheets etc. This is usually done in class time, though you might be able to adapt the method for students to do their learning

outside of class time. (See On Line Research in Handout 9).

- The students now form new groups. Each new group is a 'jigsaw', with one student from each of the four original groups. Any students left over act as pairs in a full group. Each group now has one 'expert' in each of the four tropical diseases. (They may have two experts in one disease).

Jigsaw Process: Tropical Diseases

Step 1: Research

Each group studies their assigned disease in terms of:

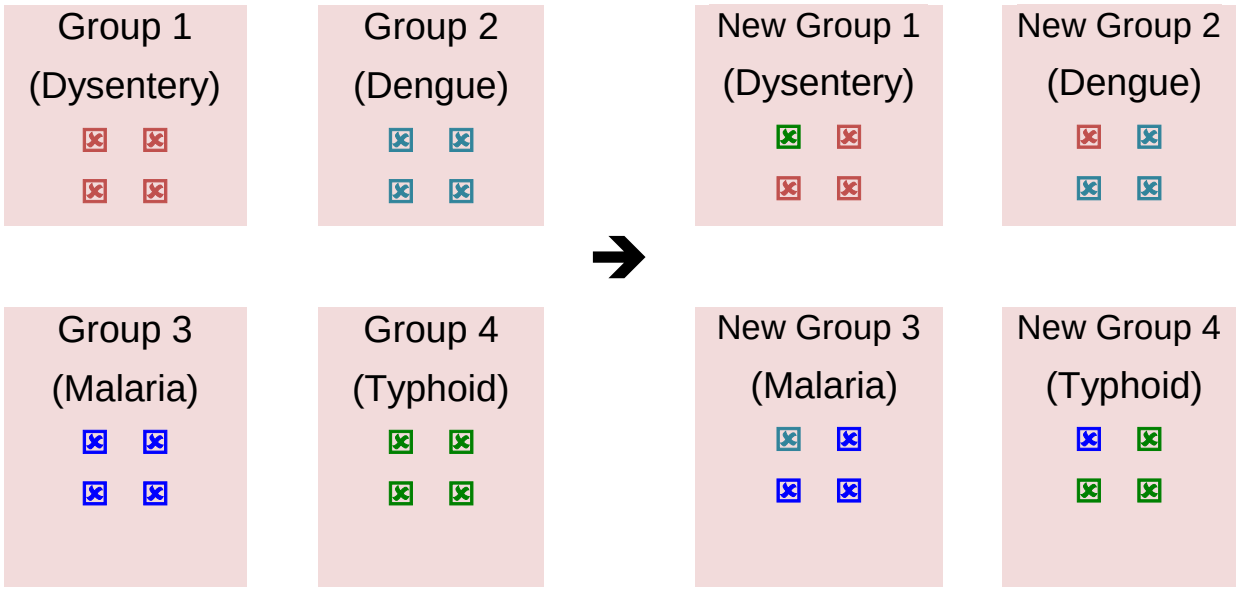
- Mode of transmission
- Symptoms
- Incubation period
- Prevention
- Treatment

Step 2: Jigsaw

One person from each group joins a different group to train them on their particular disease.

They must create a uniform matrix that summarizes the characteristics of each disease

Then, they must complete the Jigsaw Questions shown in the box below.



= Expert in Dysentery

= Expert in Dengue

= Expert in Malaria

= Expert in Typhoid

- The new group now completes an activity that requires them to

Peer Teach each other about their disease, and requires them to cooperate with the rest of the group on a combined task that requires them to integrate the four topics. For example they could be asked to:

Jigsaw Questions

- Explain your disease to the rest of your new group, using the same headings as for the earlier tasks. (incubation time, mode of transmission, etc)

  _____
  _____
  _____

- Cooperate to find three things all the diseases have in common.

  _____
  _____
  _____

- Cooperate to find, for each of the four diseases, four unique characteristics.

  _____
  _____
  _____
  _____

- Design a leaflet on tropical diseases. In your place the four diseases in order of:
  A) Severity of potential consequences
  B) Ease of protection

EXERCISE

*Using the explanation provided above, take a textbook provided by the facilitator and create a Constructivist Learning Exercise using either a **Decisions-Decisions** technique or the **Jigsaw** Technique. Be sure to explain the exercise in suitable detail including some examples of the questions, consequences, etc. that students would answer.*

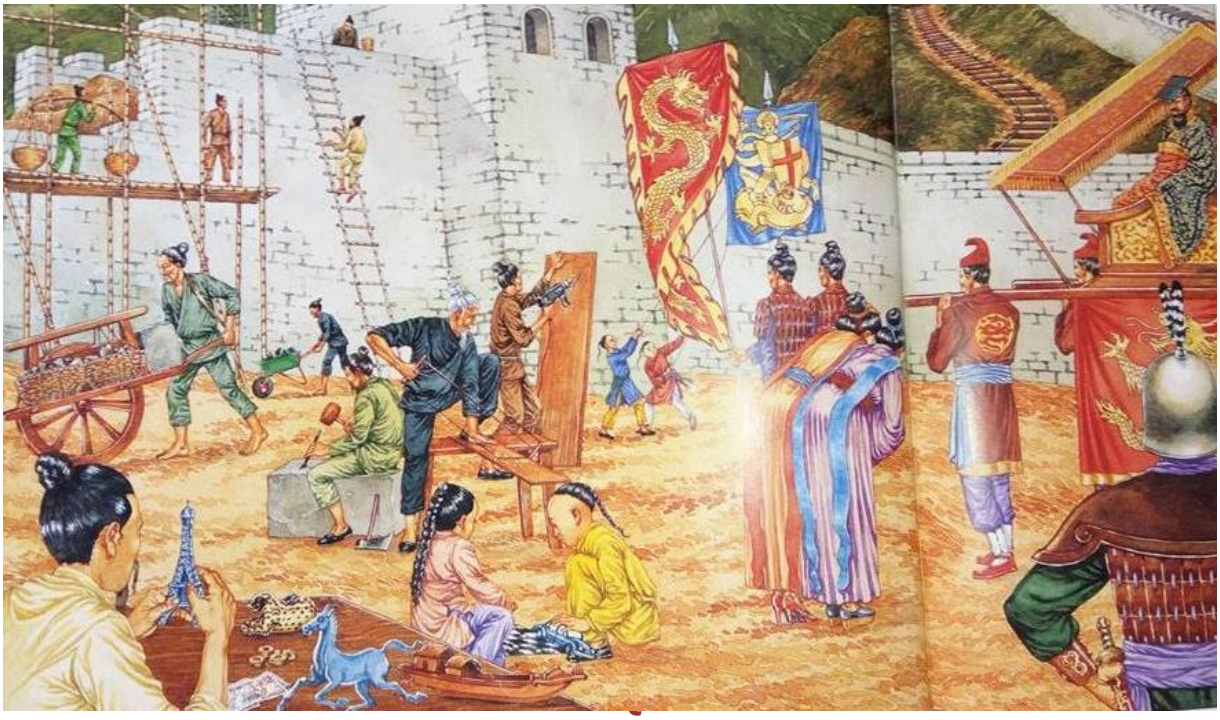
HANDOUT 7: Problem-based Learning Approaches to Promote Constructivist Learning[6]

Definition: Problem-based learning (PBL) is a Constructivist learning technique in which students learn about a subject through the experience of solving an open-ended problem. Students learn both thinking strategies and domain knowledge.

How it Works: Working in groups, students (a) identify what they already know, (b) what they need to know, and (c) how and where to access new information that may lead to the resolution of the problem. The role of the teacher is to facilitate learning by supporting, guiding, and monitoring the learning process. The teacher must build students' confidence to take on the problem, while also stretching their understanding. PBL represents a paradigm shift from traditional teaching and learning philosophy, which is more often lecture-based and assumes that students best learn when they are passive listeners.

An Example:

Directions: *The picture below displays a scene from the construction of the Great Wall of China, built by the Emperor Qin Shihuang around the year 220 BC. There are 7 things in this picture that are historically incorrect. Based on your knowledge of the period, identify these 7 things that are incorrect and explain why they are wrong.*



[6] https://en.wikipedia.org/wiki/Problem-based_learning

In your groups, discuss the following questions and prepare to report back to the large group.

1. How many errors were you able to find?
2. How did your group identify what it already knew about the problem? (For example, the time period when the wall was built, the technology available at that time, etc.).
3. How did you identify what you needed to know to solve the problem? (For example, what things were you not sure about in the picture that you needed to investigate?)
4. How did you identify what you did not yet know to solve the problem at hand?

Answers[7]

A. The ancient Chinese would not have had a modern wheelbarrow. Although the Chinese invented a device that was a precursor of the wheelbarrow called a 'wooden ox', shown here in this picture, they would not have had its modern equivalent.

B. Han Chinese craftsmen made many beautiful object such as the bronze horse shown in the picture. But they would not have made this model of the Eiffel Tower, which was only built in 1889 in France, a country unknown to the Chinese at that time.

C. The ancient Chinese would not have used money that looked like this. Ancient Chinese coins were round with holes through the middle.

D. Chinese children would not have toy cars to play with in the 3rd Century BC.

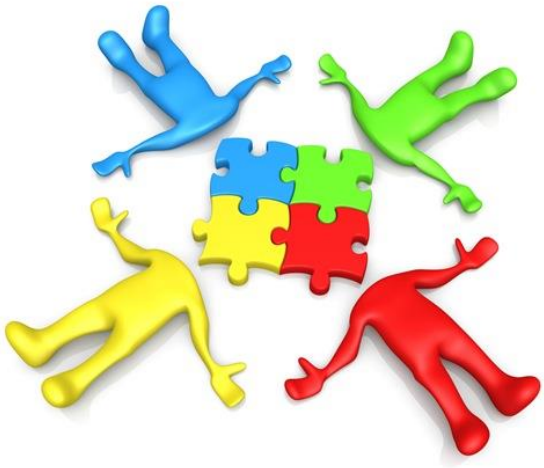
E. The ancient Chinese were excellent carpenters but they would not have an electric drill to use during this time period.

F. You would not have found the symbol of St. George, an English knight, on an ancient Chinese flag. England did not yet exist as a country at this time nor had Jesus Christ been born yet.

G. There were no railways in China until the end of the 19th Century. In 3rd Century China, goods were transported using a network of roads and canals.

[7] Wood, J. (1992) *Errata: A Book of Historical Errors,* New York: Green Tiger Press.

HANDOUT 8: Constructivist Learning Processes & Products

Examples of Constructivist Learning Process-es & Products		**Science Projects**
		**Group Work Projects**
		**Exhibitions**
		**Presentations**
		**Book Reports & Anthologies**
Creating the con-text for active learning		**On-line Re-search**
		**Field Trips**
		**Science Lab Task-work**

QUESTIONS FOR DISCUSSION

1. Which of the examples shown above are 'Processes' and which are 'Products"? How do you know?
2. Consider the *Principles of Constructivist Learning* discussed in Handout 2b. Pick a process/product for your group and explain how it exemplifies these principles by completing the table below.

   How is it *Interactive?* How is it *Authentic?* How does it *facilitate learning?* How is it *learner-centered? Etc.*

Constructivist Learning Activity	Product or Process?	How it Exemplifies a Given Principle

EXERCISE

Directions: *Review each activity and try to identify the organizational and institutional arrangements that need to be in place for the activity to occur effectively.*

Constructivist Learning Activity	Institutional Requirements
Science Projects	Provisions for a science teacher who volunteers to advise a science club Budget for materials Enough time: Either extracurricular or an extended school day Access to a Club Training Manual
Group Work Projects	

Exhibitions	
Presentations	
Book Reports & Anthologies	
On-line Research	
Field Trips	
Science Lab Task	

HANDOUT 9: Constructivism And Technology[8]

Learning is Social: If children develop best in social or group settings, then the use of technology to connect rather than separate students from one another can be highly effective.

Applying This Principle: Based on the above principle, a constructivist teacher should, therefore, create a context for learning in which students can become engaged in interesting activities that encourage and facilitate learning. The teacher does not simply stand by, however, and watch children explore and discover. Instead, the teacher may often guide students as they approach problems, may encourage them to work in groups to think about issues and questions, and support them with encouragement and advice as they solve problems, adventures, and challenges that are rooted in real life situations that are both interesting to students and satisfying in terms of the result of their work.

Technology & Social Constructivism

Technology provides essential tools with which to accomplish the goals of a social constructivist classroom. Below are a few examples of the way information technology can support social constructivist teaching and learning:

- ***Telecommunication tools*** such as e-mail and the Internet provide a means for dialogue, discussion, and debate -- interactivity that leads to the social construction of meaning. Students can talk with other students, teachers, and professionals in communities far from their class-

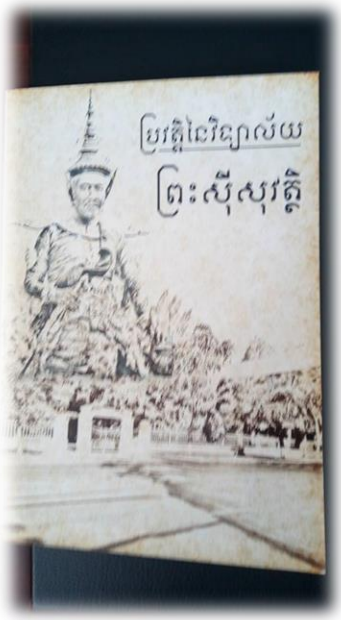
[8] http://viking.coe.uh.edu/~ichen/ebook/et-it/social.htm

room. Telecommunications tools can also provide students access to many different types of information resources that help them understand both their culture and the culture of others.

- ***PowerPoint Presentations:*** Presentations developed by students in their groups also provide a useful social channel for students to work together in teams to produce a creative product to share with the class. Schools should make LCD projectors available to both teachers and students for this purpose.

- ***Online Workstations in the Library:*** Creating easily accessible workstations in the library is another means through which students can work together on analytical tasks. The workstations may be used to solve problems assigned by the teacher, the development of Project Work, and a source of useful pictures and diagrams.

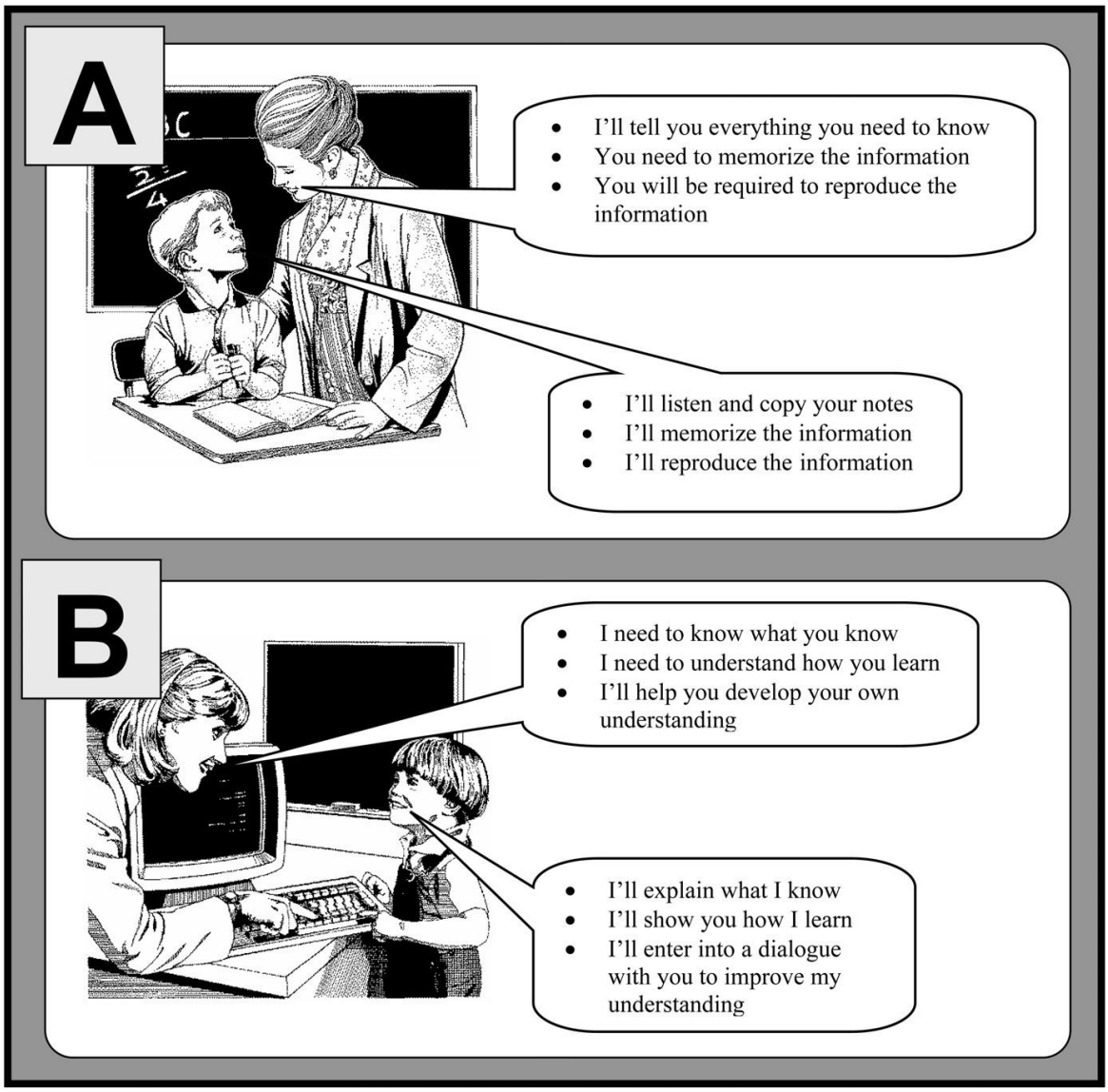
- ***Networked writing programs*** provide a unique platform for collaborative writing. Students can write for real audiences who respond instantly and who participate in a collective writing activity.



- ***Electronic Simulations*** can make learning meaningful by situating something to be learned in the context of a "real world" activity such as running a nuclear power plant, writing up "breaking" stories for a newspaper, or dealing with the pollution problems of local waterways.

HANDOUT 10: Contrasting Evaluation of Traditional Learning and Constructivist Learning

Directions: Read the dialogue below and participate in a discussion with your group to answer the questions below:



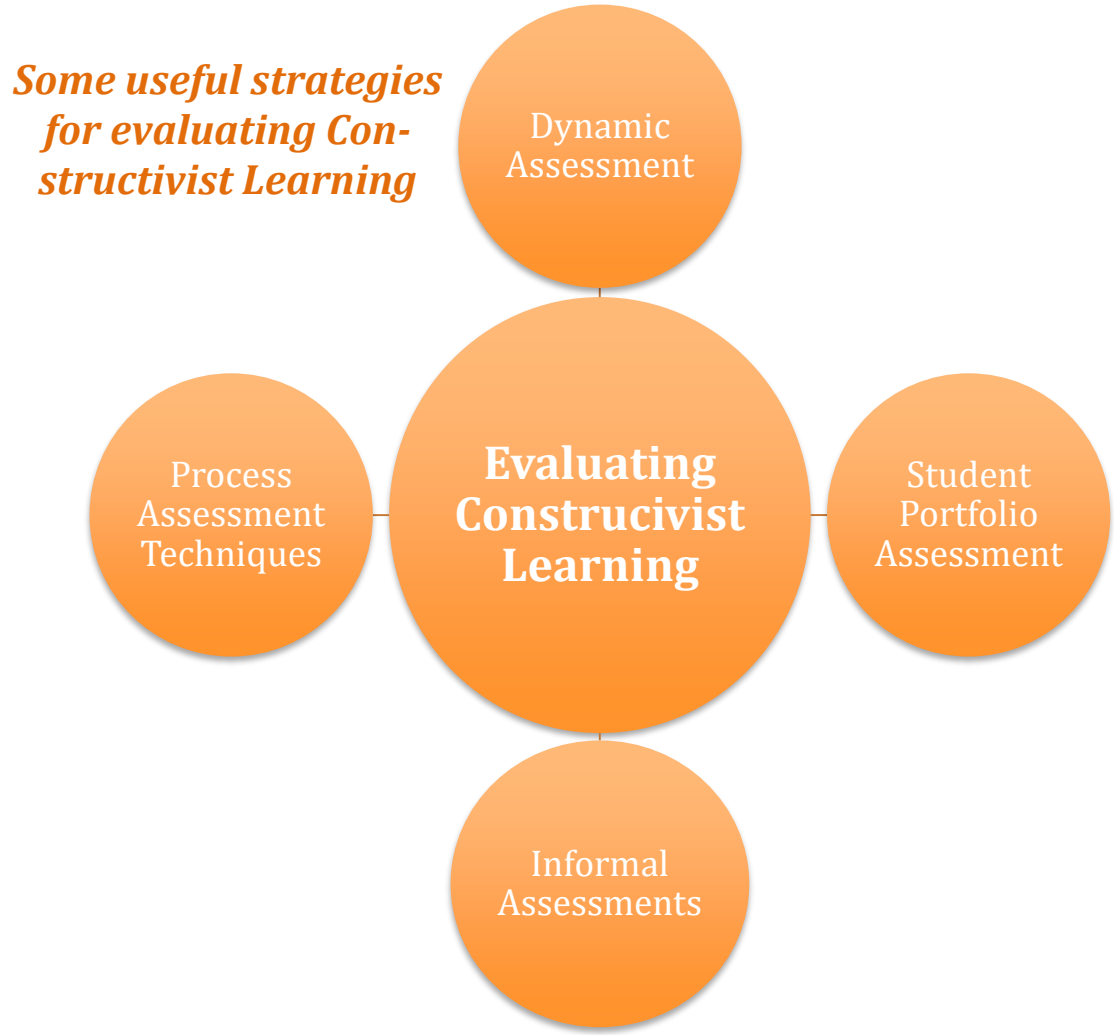
Discussion Questions

1. What levels of thinking are implied in the evaluation implied in Picture A? in Picture B? Use Bloom's Taxonomy to frame your answers.
2. List the advantages and disadvantages of the evaluation strategies implied in both Picture A and Picture B.
3. Why do you think teachers in Cambodia do not often use the evaluation strategies implied in Picture B?

HANDOUT 11: Evaluation Strategies in a Constructivist Learning Environment

Some Key Ideas

- During evaluation, Constructivist Learning teachers are usually more interested in assessing 'how' children arrived at a conclusion or answer rather than the answer itself.
- The process of learning is as important as the learning product itself.
- Traditional assessment and standardized tests do not work well for evaluating Constructivist Learning.
- Since most schools must work in a context where formal tests are unavoidable, teachers must be creative in synthesizing new assessment techniques into the existing system.



Specific Techniques for Evaluation[9]

Constructivist Learning Theorists recommend FOUR different strategies for evaluating students in a Constructivist Learning environment. These strategies often overlap in their approach but are also unique in specific ways.

- **Dynamic Assessment:** This approach suggests that teachers incorporate assessment into the teaching process where possible. Technologies are available for incorporating continuous, "dynamic assessment" into learning materials (e.g., social media, email, etc.). Assessment can then be easily integrated into meaningful learning experiences and not tacked on at the end. This type of assessment requires

[9] https://etad.usask.ca/802papers/Skaalid/eval.html

teachers to directly interact with students during the evaluation process.

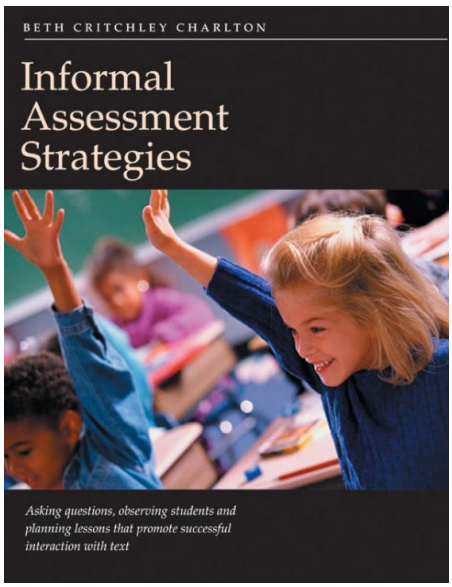
- **Portfolio Review:** In this technique, teachers critique and discuss learning products grounded in authentic contexts, including student portfolios, projects, compositions, performances, and take-home tests. Use of work products can complement more traditional measures of knowledge acquisition and understanding.

- **Process-oriented Assessment:** In this technique, teachers evaluate processes as well as products. Some of the strategies implied by this technique include: debriefings, checklists, interviews, group discussions, knowledge telling, co-investigation, and post-mortems of problem-solving activities.

- **Informal Assessment:** Informal assessments refer primarily to teacher observations of eye contact, body language, facial expressions, and work performance. These observations can complement formal assessments as a basis for instructional adjustments.

HANDOUT 12: Concrete Examples of Evaluation Strategies Used to Assess Constructivist Learning

Assessment Strategy	Examples & Explanation
Dynamic Assessment 	**E.g.,** Science group assignment where students must design their own experiment to demonstrate a specific principle learned in class. Teachers evaluate by interacting with students during the process to gauge their teamwork and understanding. **Teacher's Role:** ○ Interact with students to determine how well they work together as a team; ○ Determine whether students could undertake the research necessary; ○ Interview students to determine how they arrived at their final product; ○ Review social media or email communications to determine students' depth understanding within the group. ○ Teachers should take notes of all of their interactions and use these formatively to help students later.
Portfolio Review 	**E.g.,** Students must individually write a series of poems in Khmer using multiple poetic styles. Teachers evaluate by reviewing products and talking with students AFTER their portfolio products have been completed. **Teacher's Role:** ○ Provide materials for students to store/compile their poems ○ Allow students to work on their projects outside of class. ○ Suggest resource materials to help students do their projects. ○ Review literary products with students and ask questions about how they determined content, what was easy, what was difficult, etc.

Assessment Strategy	Examples & Explanation
	○ Assign a grade based on both the product and interactive interviews with students.
Process-oriented Assessment 	**E.g.,** Students create a Math Project that exemplifies certain key principles in a particular unit. The Project will be displayed on a classroom bulletin board. The teacher meets with students periodically to discuss the project and make assessment accordingly. **Teacher's Role:** ○ The teacher should provide the broad parameters of the project to the students but allow them to determine the form content will take. ○ The teacher holds periodic discussions with students to see how they are progressing with the project. ○ The teacher uses a *checklist* to note down progress and challenges and includes these observations in the final assessment of the project.
Informal Assessment 	**E.g.,** The teacher invites students to have a debate in English on a topic that they select. In addition to observing how well each debate team argues their particular side of the argument, the teacher makes conscious observations of students' facial expressions, energy levels, and engagement. **Teacher's Role** ○ The teacher observes the debate that was assigned to students. ○ In addition to a checklist that she may use to evaluate the use of appropriate debating techniques, she also makes conscious notes about students' facial expressions, energy levels, and engagement. ○ Informal observations are then com-

Assessment Strategy	Examples & Explanation
	bined with more formal process-oriented evaluation criteria (e.g., checklist scores) to make an overall assessment of students' learning and performance.

Small Group Discussion

In your small groups, contribute to a discussion about the similarities and differences between the various assessment strategies described in the table above. Then, complete the table provided below that summarizes how these techniques are similar and how they are different from each other.

Factor	Dynamic Assessment	Portfolio Review	Process-oriented	Informal Assessment
Timing (e.g., before, during, end of task)				
Product Focus (e.g., strong, weak, etc.)				
Process Focus (e.g., strong, weak, etc.)				
Teacher Interaction (e.g., strong, weak, etc.)				
Use of Formal Assessment Techniques (e.g., checklists, tests, etc.)				