

Designing learner-centric e-learning in STEM disciplines
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Lecture-13
Learning by doing (LbD)

From our experience as teachers or even as students, we know that in order to tell learn something effectively learners need to go beyond listening to lectures or watching videos or reading text or following procedural instructions. So, how does this apply when we design e-learning content? Let us first examine a learning scenario and pause at a reflection spot.

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The slide features a title bar at the top with the text "Scenario + reflection spot" and several icons. The main content area contains a paragraph of text and a large blue pause button. A woman in a red shirt is visible in the bottom left corner, and a small logo is in the bottom left. The text at the bottom reads "Learner-centric e-learning in STEM".


Scenario + reflection spot

An instructor created a week long e-learning module which had 5 sub-topics. He created 5 interactive videos and then sequenced it one after the other. At the end of the module, he gave a quiz. Do you think this is a good pedagogical design? Or can it be improved?

Learner-centric e-learning in STEM

An instructor designed and created material for a week long e-learning module which had 5 sub-topics. So, he created 5 interactive videos for each of the sub-topics and then sequenced it one after the other in some logical sequence. At the end of the module he gave a quiz based on the topics in each of the videos. Do you think this is a good pedagogical design for an e-learning module? Or does it have some limitations and you think it can be improved? Pause at this reflection spot, think about the answer, submit your answer and then we can resume.

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Discussion of reflection spot

Positives –

- Teacher chunked the topic into smaller units
- Created interactive videos
- Gave a quiz for practice

Limitations –

- No opportunity for immediate application & practice
- Quiz comes at the end, mostly for grading
- Usually late feedback of the form correct / wrong

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Some of you may have appreciated that this teacher in fact, chunked the topic into small meaningful units and created interactive videos, he even gave a quiz for practice, but this pedagogical design has some limitations. Primarily, students do not get the opportunity for immediate application and practice after they learn the content from each of the interactive videos. The quiz comes at the end and often it is used in a summative manner; that means, it is used for grading and the feedback on the quiz if any, is usually of the type correct or wrong. So, because of these limitations this is not the ideal design.

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Discussion of reflection spot

What students need are:

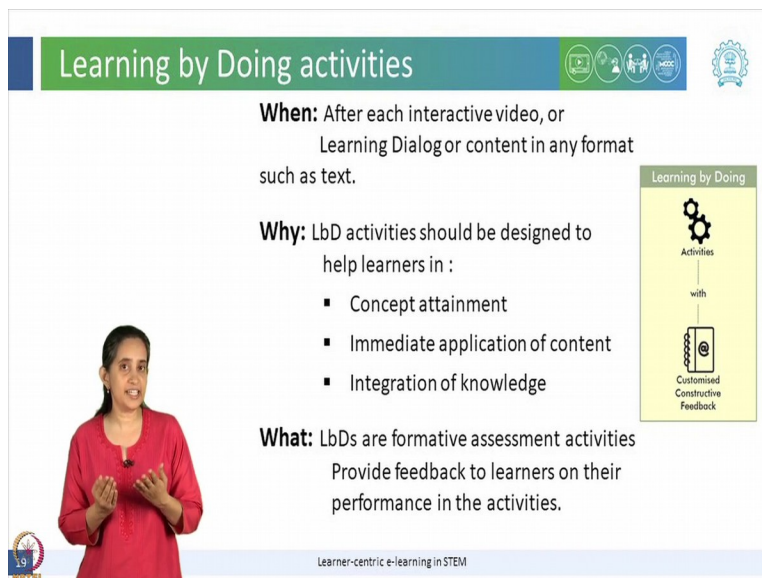
- Multiple and frequent opportunities to practice
- Apply learning from preceding content
- Get feedback to improve.

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What students need are: multiple and frequent opportunities to practice, apply the learning from the preceding content and feedback to improve. So, as instructors we need to design such activities and also give immediate feedback.

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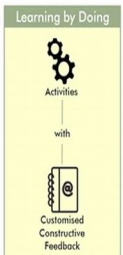
Learning by Doing activities



When: After each interactive video, or Learning Dialog or content in any format such as text.

Why: LbD activities should be designed to help learners in :

- Concept attainment
- Immediate application of content
- Integration of knowledge

What: LbDs are formative assessment activities
Provide feedback to learners on their performance in the activities.



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We call such activities learning by doing activities, after each interactive video or learning dialog or content in any format even such as text, we need to provide these LBD activities. Learning by

doing activities should be designed so that they help learners in concept attainment, immediate application of content and integration of knowledge.

Learning by doing activities are formative assessment activities; that means, they help to close the learning loop and learners should get feedback from their performance on their performance in these activities on how they can revise their learning and improve their understanding.

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The slide is titled "What is the principle?" in a green header bar. Below the title, the text "Facilitate students' **active learning**" is displayed. A bulleted list follows: "▪ Apply learning immediately, frequently", "▪ Get constructive feedback", and "▪ Revise learning". To the left of the list, a woman in a red top is speaking. To the right, two icons represent assessment types: a clipboard with a pencil for "Within video activities formative assessment questions." and a clipboard with a play button for "Intersperse activities between videos". The NPTEL logo is in the bottom left, and the text "Learner-centric e-learning in STEM" is in the bottom right.

What is the principle?

Facilitate students' **active learning**

- Apply learning immediately, frequently
- Get constructive feedback
- Revise learning

Within video activities formative assessment questions.

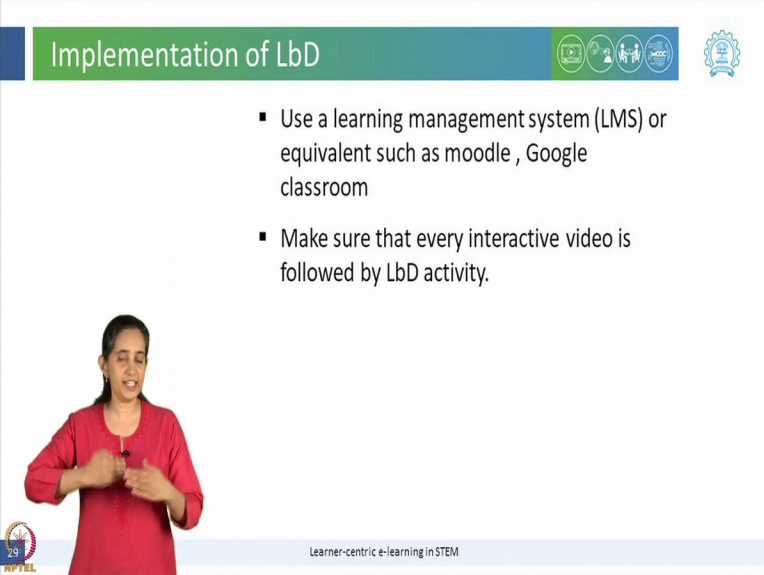
Intersperse activities between videos

NPTEL

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The principal here is that we need to facilitate students active learning; that means, we need to help them apply learning immediately and frequently, we need to help them get constructive feedback and that helps them revise their learning, in designing e-learning content, we need to do the above both by providing in video activities which we saw in a previous learning dialogue and providing activities between videos which we are calling as learning by doing activities.

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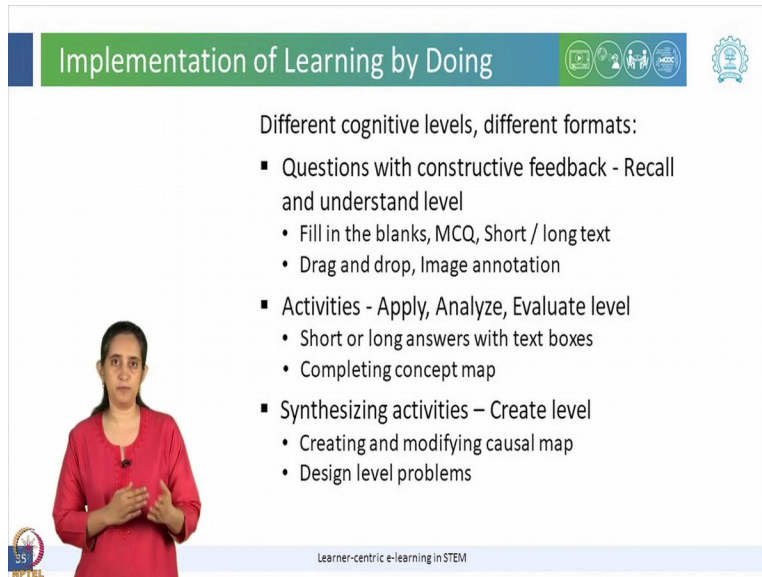
Implementation of LbD

- Use a learning management system (LMS) or equivalent such as moodle , Google classroom
- Make sure that every interactive video is followed by LbD activity.

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To implement learning by doing activities in an e-learning module, it would be preferable to use a learning management system or equivalent such as moodle or Google classroom or your own LMS that you may be using in the in your organization and this LMScan be used to sequence the interactive videos and activities in between for each module. Even if you are using something minimal like an html page, the same idea can be used that you sequence some content either video or text content followed by an learning by doing activity followed by the next piece of content and so on.

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The slide is titled "Implementation of Learning by Doing" in a green header bar. Below the title, on the left, is a video inset of a woman in a red top. To her right, the text "Different cognitive levels, different formats:" is followed by a bulleted list. The list is organized into three main categories: "Questions with constructive feedback - Recall and understand level", "Activities - Apply, Analyze, Evaluate level", and "Synthesizing activities – Create level". Each category has sub-bullets. At the bottom left is a small circular logo with the number 35, and at the bottom right is the text "Learner-centric e-learning in STEM".

Implementation of Learning by Doing

Different cognitive levels, different formats:

- Questions with constructive feedback - Recall and understand level
 - Fill in the blanks, MCQ, Short / long text
 - Drag and drop, Image annotation
- Activities - Apply, Analyze, Evaluate level
 - Short or long answers with text boxes
 - Completing concept map
- Synthesizing activities – Create level
 - Creating and modifying causal map
 - Design level problems

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NPTEL

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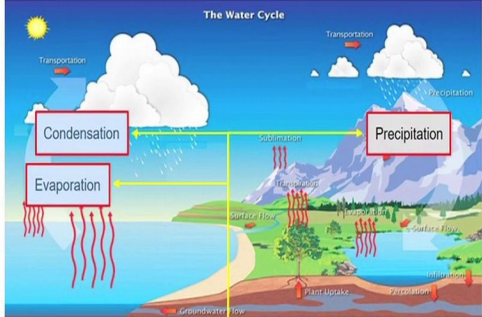
Learning by doing activities can be at different cognitive levels and can use a variety of formats. For example; a large number of LbD activities should be at recall and understand levels so that learners can get a lot of practice in just applying the concepts in testing their understanding of the concept. These recall and understand level questions can be in the form of multiple choice questions with one or more correct answer, simple drag and drop activities perhaps annotating images with labels and so on.

Another level a slightly higher level of LbD activities require the learner to apply the content. So, these could be in the form of solving problems and in terms of the format, we can give short or longer answer questions with text boxes, we can provide them concept maps that they can modify and so on, we will see a few examples in a moment. And if we go at a higher level which is also required for integration of knowledge, we need to provide synthesis or create level activities, longer problems perhaps design problems and we don't need to do this too often because that will be this comes after a set of concepts are learnt, but these do need to be included in the e-learning module.

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Example LbD with image – Drag and drop

Drag and drop for water cycle



In this Learning by Doing activity created using H5P –

- Different processes in Water cycle is converted into labels that can be dragged and dropped.
- Learners need to place the labels at correct position in the picture.
- This is an understand level activity.

Drag and Drop Labels

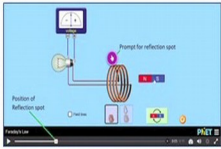
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Let us see some examples of these different types of LbD activities; here is an example LbD at an understand level where there is an image. So, what do you see is an image of different processes in the water cycle and this is converted into labels that can be dragged or dropped dragged and dropped by the learner onto the image. So, learners need to place the labels at the correct picture in order to finish the activity and this is an understand level activity.

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Example LbD activity at Apply level

Predict - Observe - Explain



Step 1: Predict - What will happen when a magnet is dropped in a copper tube?

Type your answer here

Step 2: Observe – Watch this video
(<https://www.youtube.com/watch?v=5BeFoz3Ypo4>)

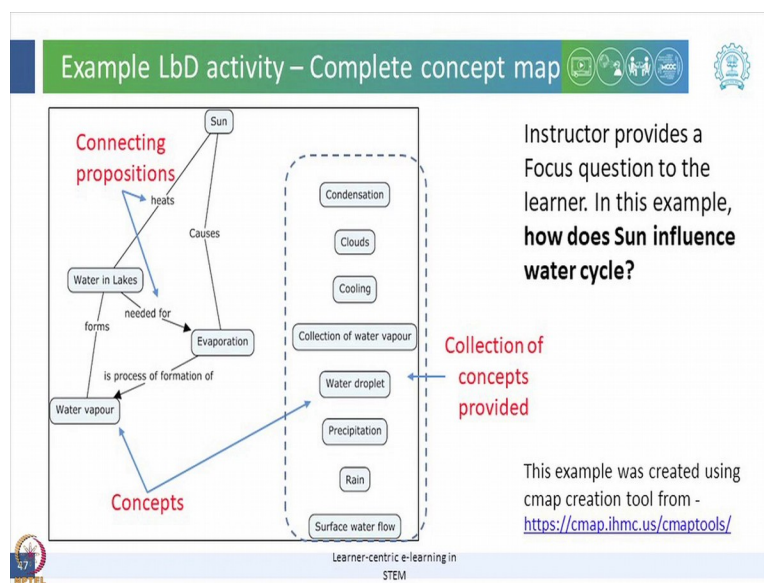
Step 3: Explain – Apply Faraday's law of electromagnetic induction to explain the phenomena you observed in the video.

Type your answer here

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The next example is that at an apply cognitive level and the technique used here is called predict, observe and explain. So, you may recall the learning dialog example that we saw in a previous LeD about a magnet and movement of a magnet in a circuit and so on. So, after that interactive video, learners can be asked to predict what will happen when a magnet is dropped into a copper tube and they can type their answer, then they can be asked to observe a different video to test their answer and finally, they can be given another text box wherein they apply the corresponding laws to explain the phenomena observed in the video.

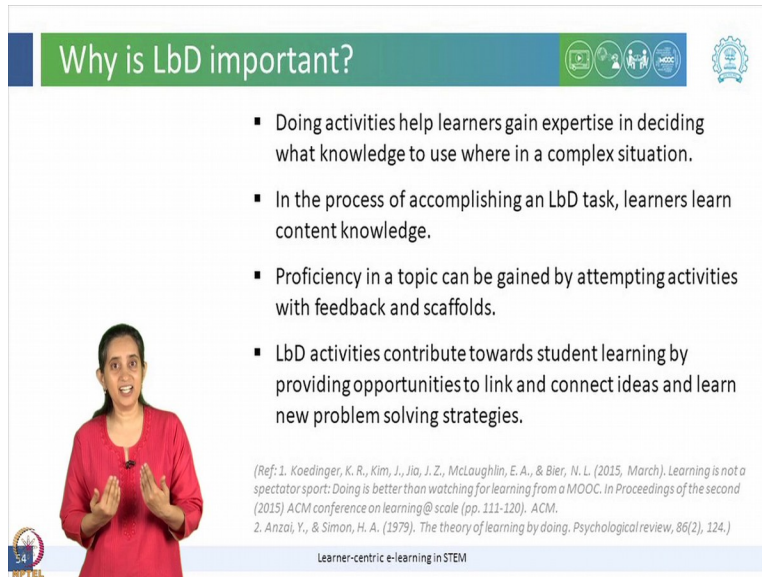
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The next example is could be perhaps even at a higher level or apply or even at an analysis level and this involves completing of a concept map. Here the instructor provides a focus question to the learner, in this example the focus question is how does the sun influence the water cycle and a group collection of concepts involves a involved are provided. What the learner has to do is to connect the concepts with meaningful propositions, so that together the concept map can answer the focus question.

Alternately a partial concept map or perhaps a slightly incorrect concept map could be provided and the learner can evaluate and correct the map. So, again this activity can be at an analyze or even at an evaluate level.

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The slide features a green header with the title "Why is LbD important?". To the right of the title are four circular icons representing different aspects of learning by doing. A presenter, a woman in a red top, is visible on the left side of the slide. The main content consists of four bullet points. At the bottom left, there is a small circular logo with the number 54. At the bottom right, there is a small rectangular logo with the text "Learner-centric e-learning in STEM".

Why is LbD important?

- Doing activities help learners gain expertise in deciding what knowledge to use where in a complex situation.
- In the process of accomplishing an LbD task, learners learn content knowledge.
- Proficiency in a topic can be gained by attempting activities with feedback and scaffolds.
- LbD activities contribute towards student learning by providing opportunities to link and connect ideas and learn new problem solving strategies.

(Ref: 1. Koedinger, K. R., Kim, J., Jia, J. Z., McLaughlin, E. A., & Bier, N. L. (2015, March). Learning is not a spectator sport: Doing is better than watching for learning from a MOOC. In Proceedings of the second (2015) ACM conference on learning@scale (pp. 111-120). ACM.
2. Anzai, Y., & Simon, H. A. (1979). The theory of learning by doing. Psychological review, 86(2), 124.)

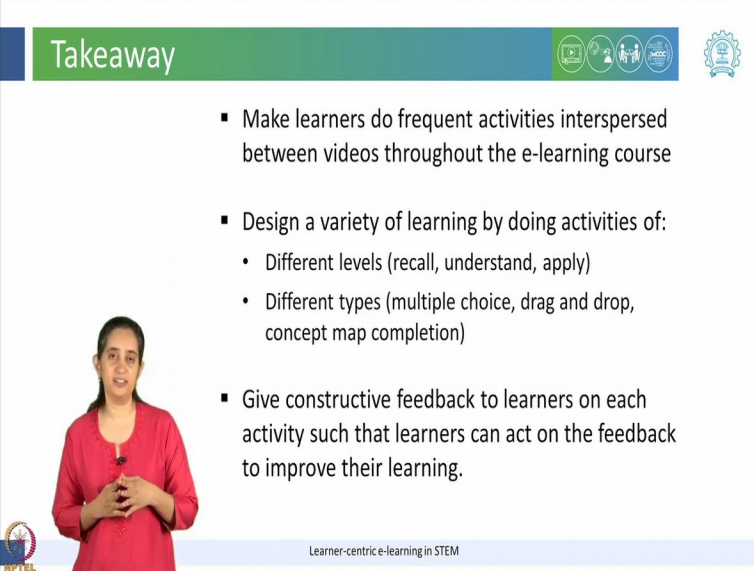
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So, why are these learning by doing activities important? Doing LbD activities help learners decide which knowledge, which content which concepts are to be used in which situations and this becomes very important when there is a complex situation, a complex scenario fairly common in various STEM disciplines and even in other disciplines. In the process of attempting a learning by doing task, a learners conceptual understanding their application of the concept becomes stronger.

Proficiency in a topic can be gained by attempting activities with feedback and scaffolds and learning by doing activities contribute towards student learning by providing them opportunities to link and connect ideas and learn new problem solving strategies.

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Takeaway

- Make learners do frequent activities interspersed between videos throughout the e-learning course
- Design a variety of learning by doing activities of:
 - Different levels (recall, understand, apply)
 - Different types (multiple choice, drag and drop, concept map completion)
- Give constructive feedback to learners on each activity such that learners can act on the feedback to improve their learning.

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Finally let us come to some takeaways for us instructional designers and teachers as we use a learning learner-centric approach to design e-learning content. We need to make learners do frequent activities which are interspersed between videos throughout the course, we need to design a variety of learning by doing activities at different cognitive levels and in a variety of formats and we need to give constructive feedback to learners, so that they can revise their understanding and improve their learning.

Thank you.