

Creating TBL Module Components

The typical TBL module is backward designed (See Wiggins and McTighe). First consider "what I want the students to be able to do" by the end of the module or course, then "how will I know they can do it", then "what do I need to help them with to succeed.

The typical 2-week TBL module start with students completing assigned pre-readings or other advanced preparation, and then at the first class meeting they complete the Readiness Assurance Process (multiple choice test). By the end of the Readiness Assurance you have some "assurance" that your students have the important foundational knowledge to begin problem solving. The rest of the module focuses on having students solve problems using the 4 S's framework. During the problem-solving process you get opportunities to provide short expert clarification on concepts that the students are still having the most trouble with. The module ends with a short instructor-led review and closure activity.

To construct a TBL module you will need to complete the following tasks:

Develop Goals and Objectives

- Describe Context
- Establish Instructional Goals
- Define Learning Objectives

Create RAP process to help students develop an understanding of the important foundational knowledge of the module.

- Select Readings/Design Advanced Preparation
- Write RAT Questions

Design Activities/Problems that require application of the course concepts.

- Design Application Activity
- Develop Facilitation Plan

Getting Started

Step 1 – What is the application I want to develop?

- The most efficient way to develop a TBL case is to start with the application. By understanding the ultimate objective, we can design readings, tests and activities that help the students achieve these objectives.
- It can be most time efficient if a series of application questions pertaining to one case or scenario. You can use the same scenario and examine it in different ways. Using the different scenarios can consume extra time for students to read each scenario.
- It can be efficient at this point to brainstorm out a long list of situations that students will need to use this information to solve real problems, either in their everyday life or in the workplace. Once you have a long list you can select and focus on problem-solving situation that really require students to use the "content" to solve that particular problem.

- Students are often given a worksheet that contains a series of questions to be answered in solving a particular problem. The student teams often work through the entire worksheet, and then using the simultaneous reporting the facilitator revisits each question and has the student teams discuss, defend and analyze their solutions to the questions.

Step 2 – What is the core knowledge needed to solve the scenario/case/problem?

- Once you know the problem you want students to solve, you can map the problem back to the important foundational knowledge that the students will need. Understanding the important foundational knowledge helps you select appropriate readings and design effective RAT questions.
- Now you will need to write the multiple-choice questions for the RAT that test on basic knowledge; these don't need to be comprehensive, just foundational knowledge (maybe the vocabulary of the discipline).
- The questions are based on the information that the students MUST understand to solve the case; if the students are going to be deciding on good answers for your case questions, they need to understand the important foundational knowledge.

Step 3 – How do I help the students prepare for the TBL activity?

- The students should be prepared for the activities by using the Readiness Assurance Process (Readings/IRAT/TRAT/Appels/Mini-lecture).
- Since students work under tight schedules, specific learning objectives will help them to focus on the knowledge that pertains directly to the team-based learning activity.
- Write a list of learning objectives, by starting with your RAT questions. Then add any additional objectives if the students need to review any special aspects of the material. Keep in mind that the learning is confined just to the material you are teaching with minimal introduction of new concepts. A reading guide can be useful to focus student attention on important special aspects of the material.

Case Application Question Example (from John Pelly - Wright State)

A 74 year old female has come to your office suffering from hyperventilation, malaise, dizziness, and muscle pains. She was diagnosed with Type 2 diabetes at the age of 50 and has managed her disease successfully with diet, exercise, and hypoglycemic agents. She was initially put on a hypoglycemic agent called an oral sulfonylurea (chlorpropanide), but recently was switched to metformin which is better tolerated in the elderly. Her blood pH is 7.2 and her serum lactate is 10X normal levels. Her creatinine clearance and serum creatinine concentrations indicate diminished renal function.

1. This patient has a blood pH of 7.2 because
 - A. ketones from excess fat mobilization are making her blood acidic.
 - B. increased glycolysis and reduced TCA cycle activity leading to excess lactate formation.
 - C. hypoxia resulting from inhibition of electron transport is creating excess carbon dioxide.
 - D. increased blood sugar increasing glycolysis and lactate production in red blood cells.
2. Metformin action in the production of lactic acidosis is most analogous to which of the following?
 - A. Fluoride
 - B. Pentachlorophenol
 - C. Cyclic AMP
 - D. Oligomycin
3. Metformin-induced lactic acidosis in this patient was precipitated by
 - A. reduced renal function due to glycosylation of renal membrane proteins.
 - B. acceleration of glycolysis due to the increased concentration of glucose in the blood.
 - C. resistance to insulin leading to uncontrolled fat mobilization.
 - D. accelerated gluconeogenesis in the liver due to insulin resistance.

Readiness Assurance Test Example (from John Pelly - Wright State)

Give the single best answer.

1. Which of the following would NOT produce lactic acidosis?
 - A. Carbon monoxide poisoning
 - B. Impaired gluconeogenesis
 - C. Impaired pentose phosphate shunt
 - D. Impaired pyruvate oxidation
 - E. Cyanide poisoning
2. The rate of glycolysis is increased by:
 - A. glucose 6-phosphate.
 - B. fructose 2,6 biphosphate.
 - C. citrate.
 - D. lactate.
 - E. acetyl-CoA
3. Which of the following best describes the role of lactate dehydrogenase?
 - A. disposal of excess NADH in fast twitch muscle cells
 - B. utilization of lactate for energy in red cells
 - C. conversion of lactate into TCA cycle intermediates
 - D. synthesis of pyruvate during hypoxia
 - E. shunt pathway for pyruvate to enter gluconeogenic pathway
4. Which of the following is true for the nonenzymatic glycosylation of proteins?
 - A. It is a fast and reversible reaction.
 - B. It forms a stable reaction product.
 - C. It involves the formation of ester bonds.
 - D. Glycosylated sites are genetically determined.
 - E. Sorbitol is the final form of the sugar attached .
5. Which of the following best describes fat mobilization in the diabetic?
 - A. Lipolysis leads to ketoacidosis in Type 2 diabetes
 - B. Lipolysis only occurs in the Type 1 diabetic.
 - C. Lipolysis is due to activation of lipoprotein lipase
 - D. Metformin would likely suppress lipolysis in adipose tissue.
 - E. Formation of ketones can be regulated in the liver.

Learning Objectives, Supplementary Information

I. Learning Objectives (Sources are: Lecture notes from Block 1; pp 303-304, Meisenberg; Supplementary Information below; pp 653-657, Meisenberg)

- A. Give a definition for lactic acidosis. At what pH does a patient enter acidosis?
- B. Describe the steps leading to increased lactate production resulting from hypoxia.
- C. List the various causes of hypoxia.
- D. Describe the action of rotenone, amytal, antimycin A, oligomycin, and pentachlorophenol in the mitochondrion.
- E. Describe the action of fluoride on glycolysis.
- F. Describe the metabolism of lactate by the liver in the normal patient.
- G. Describe the steps involved in the nonenzymatic glycosylation of proteins. What is the effect of this process in renal glomeruli?
- H. Describe the activity of the polyol pathway in type 2 diabetics.
- I. Compare the effect of insulin on gluconeogenesis in a normal patient and a patient with Type 2 diabetes.
- J. Give the two causes of hyperglycemia in diabetes mellitus.
- K. Compare fat mobilization in type 1 and type 2 diabetes.

II. Supplementary Information (Also, see pp 653-657 in Meisenberg)

Diabetes supplementary facts

- Type 2 diabetes occurs in nearly 19% of those between 65 and 74.
- Nearly half of those with Type 2 diabetes are over 60 and half of those are undiagnosed.
- Risk factors for Type 2 diabetes are visceral adiposity, increasing age, and lack of physical activity.
- Type 2 patients develop impaired renal function.
- Type 2 diabetes is characterized by insulin resistance:
 - Insulin is present in the blood, but is required at higher concentrations than normal.
 - The intracellular signal that is produced when insulin binds to its cell surface receptor is diminished.
- Elevated blood sugar is largely due to *inability to suppress gluconeogenesis* in the liver.

Metformin therapy – supplementary information:

- The specific action of metformin is not known with certainty, but it seems to work generally by increasing insulin sensitivity, i.e. increasing the intracellular signal response to insulin
- Metformin inhibits gluconeogenesis (from whence it gets its common name, “glucophage”). Thus, it prevents lactate conversion to glucose in the liver; lactic acidosis is a side effect.
- Metformin is also thought to inhibit oxidative phosphorylation. This would reduce ATP production and cause an increase in NADH concentrations.
- Metformin and reduced renal function occur together with most cases of lactic acidosis.
- Reduced renal function causes circulating metformin concentrations to increase causing a functional overdose of this drug.

Generic Question Templates

1. How is _____ like _____ ?
2. How are _____ and _____ different?
3. Compare _____ before and after _____.
4. What caused _____ ?
5. What is another possible cause of _____ ?
6. In what sequence did _____ happen?
7. Break _____ down into its component parts.
8. Give an example of _____.
9. Into what groups can you organize the following?
10. What information is needed?
11. Is the following information relevant?
12. What is the relationship between _____ and _____ ?

NBME Question Templates¹

Sample Templates For Learning Objectives And/Or Test Questions

- a. Make a simple paraphrased definition of [terms].
- b. What concepts are related to [terms]?
- c. List causes and/or effects of [terms].
- d. Compare or contrast [terms] with one or more [terms].
- e. Describe the relationship between [terms] and [terms].
- f. Explain the function of each step in (*a sequence or a process*).
- g. What do [terms] have in common and how are they different?
- h. What symptoms would be produced if (*process, structure, etc.*) were defective?

Sample Item-Writing Templates and Lead-Ins

- 1) Item Stem (Patient Vignette): (*Describe a patient with a problem*)
- 2) Lead-In: A defect is most likely to be present in which of the following structures/processes?
- 3) Options: (*List of structures/processes*)

Also the following are general problem set-ups

Insert patient vignette describing a patient with a problem. Which of the following is the most likely disorder of the knee?

Insert patient vignette describing a patient with a problem. Which of the following is the vessel into which contrast medium should be injected during fluoroscopy to visualize the site of the abnormality?

Insert patient vignette describing a patient with a problem. Which of the following gastrointestinal disorders is the most likely cause of these findings?

Histology/Cell Biology Items

Insert description of "action". Which of the following cellular organelles is most directly involved?

- A. Golgi complex
- B. Lysosome
- C. Peroxisome
- D. Mitochondria
- E. Nuclear envelope
- F. Secretory (zymogenic) granule
- G. Rough endoplasmic reticulum
- H. Smooth endoplasmic reticulum

Lab Vignette Example

Several contiguous cells are labeled with a fluorescent dye that cannot cross cell membranes. One cell is experimentally bleached with a light that destroys the dye but soon recovers dye fluorescence. This recovery is best explained by the presence of which of the following structures between the bleached cell and its fluorescent neighbors?

- A. Basal lamina
- B. Desmosomes (maculae adherentes)
- C. * Gap junctions
- D. Glycosaminoglycans
- E. Tight junctions (zonulae occludentes)

Template for Mechanisms

Item Stem (Patient Vignette): (*Describe a patient with a problem*)

1. Lead-In: Which of the following mechanisms is the most likely cause of the patient's findings?
2. Options: (List of mechanisms)

Additional Templates

- A (*patient description*) has a (*type of injury and location*). Which of the following structures is most likely to be affected?
- A (*patient description*) has (*history findings*) and is taking (*medications*). Which of the following medications is the most likely cause of his (*one history, PE or lab finding*)?
- A (*patient description*) has (*abnormal findings*). Which [*additional*] finding would suggest/suggests a diagnosis of (*disease 1*) rather than (*disease 2*)?
- A (*patient description*) has (*symptoms and signs*). These observations suggest that the disease is a result of the (*absence or presence*) of which of the following (*enzymes, mechanisms*)?
- A (*patient description*) follows a (*specific dietary regime*). Which of the following conditions is most likely to occur?
- A (*patient description*) has (*symptoms, signs, or specific disease*) and is being treated with (*drug or drug class*). The drug acts by inhibiting which of the following (*functions, processes*)?
- A (*patient description*) has (*abnormal findings*). Which of the following (*positive laboratory results*) would be expected?

- (time period) after a (event such as trip or meal with certain foods), a (patient or group description) became ill with (symptoms and signs). Which of the following (organisms, agents) is most likely to be found on analysis of (food)?
- Following (procedure), a (patient description) develops (symptoms and signs). Laboratory findings show (findings). Which of the following is the most likely cause?
- A (patient description) dies of (disease). Which of the following is the most likely finding on autopsy?
- A patient has (symptoms and signs). Which of the following is the most likely explanation for the (findings)?
- A (patient description) has (symptoms and signs). Exposure to which of the (toxic agents) is the most likely cause?
- Which of the following is the most likely mechanism of the therapeutic effect of this (drug class) in patients with (disease)?
- A patient has (abnormal findings), but (normal findings). Which of the following is the most likely diagnosis?

¹ NBME Item Writers Guide, www.nbme.org

A Taxonomy of Learning¹

1. Evaluation – What is predicted? [clinical treatment and management]
 2. Inference – What is concluded? [diagnosis]
 3. Comparison – How are patterns related?
 4. Analysis – How are facts grouped into patterns?
 5. Recall – “Just the facts ma’am”
- (Note that each level uses the levels below it)

Sample learning objectives for learning taxonomy:

Evaluation – Develop a treatment plan for a type 2 diabetic.

Inference – Justify your diagnosis of type 2 diabetes.

Comparison – Explain how type 1 and type 2 diabetes are different.

Analysis – Give the characteristics of type 1 diabetes.

Recall – Define hyperglycemia, ketoacidosis, glycosylation

¹ Quellmalz taxonomy of learning, see attached documents obtained from the Internet.

Writing Learning Objectives

Learning objectives ask for a specific behavior that demonstrates learning. Goals are broad outcomes that do not demonstrate a specific behavior.

Well crafted learning

Examples:

Objective – Compare the pathologic outcomes of type 1 and type 2 diabetes.

Goal – Understand type 2 diabetes.

To write a learning objective:

1. Refer to the taxonomy of learning to determine the level of learning required.
2. Phrase the learning objective as an essay test question; if you could not answer the objective as an essay test question, start over.

