

# Module 3E: Difficulty and Cognitive Complexity

by Dr. Tim Brophy

Hello. My name is Tim Brophy, and welcome back to Passport to Great Teaching Creative Assessment. This is module 3e. And in this module, I'm going to introduce to you the ideas of item difficulty and cognitive complexity.

So what is item difficulty? Well, as you develop any assessment item, you're going to make some kind of prediction based upon your knowledge of what students know and are able to do at a given course or skill level. All right. You know what they know, and then you can predict basically the percentage of students that you estimate that are likely to respond to the item correctly.

So how do we identify predicted item difficulty? We usually have three categories. We categorize or think of items as being easy if we think more than 70% of our students will get the item correct, average if between 40% and 70% of students get it correct, and challenging or hard if we think less than 40% of our students will get it correct.

So as you're writing items, you're kind of predicting, oh, this is going to be an easy question, or this is going to be an average question. This could be a harder question. So think about that as you're writing your items as you develop them what the difficulty level could be.

So what happens after an item is administered? So look at that spin around. All right. Item difficulty actually refers to the percentage of students who chose the correct answer.

So when a test is finished, you can actually go back, and you can calculate the percentage of students who chose the correct answer. And then you can align that percentage with the predicted level of difficulty that you thought would be the case and determine the degree to which your item matches what students actually produced. And it's always good to have a combination of easy, average, and challenging items on any assessment.

Let's talk now about the idea of cognitive complexity. Now, this is a different way of thinking about our items because this refers to cognitive demand that's associated with an item. In other words, how much the students have to think about their response in order to complete it for you to be able to assess what they know and are able to do.

This all comes from Dr. Norman Webb's idea of Depth of Knowledge, or DOK, levels. And, again, Depth of Knowledge focuses on the expectations of the item and not student ability. So this is an item-specific idea. So when you're identifying the demands that an item places on student thinking, it's assumed that the student is familiar with the basic concepts of the task. So the item itself is going to then be constructed to draw out at a

certain level of complexity the ability of students to apply those concepts in the task that you've developed.

So now let's take a couple of minutes here to really examine Webb's Depth of Knowledge, or DOK, concept. Now, Depth of Knowledge is the degree of depth or complexity of knowledge that your standards and assessments require. So you meet this criterion at the assessment that you've created is as demanding cognitively as the expectations you set for your students.

So there are basically four levels of Depth of Knowledge that Norman Webb has defined for us. The first level is recall. That's level 1. The skill or concept level is level 2. Strategic thinking is level 3. And extended thinking is level 4.

Now, I'm not going to get into a lot of detail about what those mean in this particular module. But if you look up Dr. Norman Webb and you look up Depth of Knowledge, or DOK, you'll find lots and lots of information about that available for you if you want to go into that more deeply. Of course, if you're going to accurately evaluate a Depth of Knowledge level, you really need to define each level and give examples of the types of student behaviors that you expect. So it's going to be important for you to do that to define what levels of expectations you would expect your students to do at the recall level, the skill or concept level, the strategic thinking level, and the extended thinking level.

Continuing on, so this implies that there is some kind of interaction of how deeply a student needs to understand the content you've taught them with different ways of responding and interacting with that content. So now we're really thinking about our items in a very different kind of a way. So when we present an item to a student, we want to be sure that they are responding and engaging with the item in ways that we expect them to.

So, again, the level of depth of knowledge for any item is determined by the task. All right. Remember, that's defined by the level of complex thinking and reasoning skills that are in the task, not the level or ability of the student. So we're not talking about student ability here. We're just thinking about the task that you have created.

So verbs alone don't determine Depth of Knowledge. OK. The focus is on how deeply students need to know content for any given response that they produce. So, again, we're kind of breaking away from what I've told you before in earlier modules to think about our items in a new and different way.

So there are some categories of cognitive complexity. A low complexity item could require a student to solve a one-step problem. All right. A moderate complexity item, though, could require multiple steps. And a high complexity item would require a student to analyze-- maybe synthesize-- information and complete multiple steps in multiple ways to

respond to your question. So I think from these three brief definitions, you begin to think how your items might be classified in terms of their cognitive complexity.

Again, distinctions in this item complexity really do ensure that your items will assess the depth of student knowledge for the standard or benchmark or outcome that you have established. So you need to think about what is the intent of your item. What are you getting at? What do you expect students to show? What do you intend to get out of the item information that students provide?

You want to be sure you classify your items by the highest level of complexity that's demanded by the items. So as you think about what you're asking students to do, think about just how complex is this item for students? How much demand on student thinking is it going to take for them to respond?

And then the ultimate determination, again, is the overall cognitive demand that you place in your items on the student. So this is why some students find some examinations particularly demanding because they are full of highly complex questions that require and demand a lot of student thinking, a lot of cognitive interaction, with the items. So think about that as you create your examinations.

You should always evaluate your items. And you want to combine levels of complexity in your assessments so they're not one high demand item after another but some lower, more moderate, and some high complexity items in every one of your tests.

Low complexity. Let's think about that. These rely heavily on recall and recognition. So what you do with these items, clearly specify what student needs to do. And they usually are asked to recall a particular fact, a date, a title of a work, or to identify a word. These are basically one-step actions that students take.

Moderately complex items, though, are those that really involve more flexible thinking than the lower complexity items. So here, the cognitive demand is greater. So the item responses will require more than one step. For example, you might have them read a passage and identify the genre of the passage or the style or some other appropriate component related to that passage. So students expected to really reason somewhat informally but bring together still some skills and knowledge from more than one area of knowledge to answer the question that you've developed.

High complexity items are different. These really make heavy demands on student thinking. So really, we need to get students to engage in these items and really in more abstract reasoning-- planning, analysis, judgment. Creative thought is a highly complex process for students because you have to make choices, and you have to think about how you're going to plan out your creative response. All right.

So these really do require that students complete multiple cognitive tasks simultaneously. They need to analyze, synthesize, or create something to obtain their response. So this

also creates the opportunity for you as a professor or as a teacher to know a little bit more about the degree to which your students can handle these kinds of tasks. And you as a teacher are responsible for knowing the degree to which your students can handle more complex tasks so that you can create your assessments appropriately.

So I've prepared a little complexity chart with some examples. So what you might want to do is make a copy of this chart at some point because I think it provides some clear examples of each level of complexity. So here we go. All right. Let's take a look at the top bullet across all three of these.

A low complexity item would have students complete a one-step task. For example, they might recall or recognize a fact, a title of a work, or a well-known person. Whereas a moderately complex task would ask them to complete a task that requires multiple steps or maybe analyze a work involving multiple transformations of some component or element or reasoning.

Whereas the high complexity task is where they complete a real world discipline-specific task that involves multiple steps, multiple choices. Perhaps they might even describe how different representations of a work could be used for different purposes. So as you take time to examine this list yourself, you'll be able to see hopefully from these three lists the distinctions between these different cognitive complexity levels and how they might apply to what you are asking in your assessments.

So there are some resources for this module as well. There is that checklist for selected response item I've added and the list of item stem templates that I mentioned in an earlier submodule for this module. So those are there for you to use.

Now, let's think about cognitive complexity for just a moment. Think of again-- I'd like you to pull out your tests again and examine some of the existing test items. This time, though, forget about their difficulty level. Forget about their validity. Forget about the item stems and the answer choices that you've written. We've talked about all of that before.

Think now in terms of their cognitive complexity. How would you describe it for your items? Would you put them in low, moderate, or high categories? And what was your rationale for this classification? And even more importantly, does your test have a variety of these different cognitive complexity levels so that students can demonstrate what they know and are able to do through those channels?

I wish you the best. I'll see you next in module 4. Thank you.

