
Prior Knowledge and Student Learning: Assessing What Your Students Know

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Students don't enter our classrooms as empty vessels or blank slates. They come to us with prior knowledge that has shaped their beliefs, values, and assumptions about the world they live in. And this prior knowledge influences what students will pay attention to, learn and remember, or, for that matter, forget. In fact, research indicates that the single, most influential predictor of student learning—outside of socio-economic factors—is what students already know when they enter our classrooms (Ausubel, 1993; Cross & Angelo, 1993).

From a cognitive perspective, students actively construct knowledge, and it is this knowledge that directly affects their ability to construct new knowledge. When a student's understandings of a given subject are accurate, they provide the necessary foundation on which to build new knowledge. As instructors, we can build on these understandings and help our students develop more "mature" understandings (Bransford Brown, & Cocking, 2000).

However, we know from classroom experiences that students' prior knowledge can be naïve, incorrect, incomplete or illogical, and may include stereotypes, oversimplifications, or misconceptions. Such misconceptions have been the subject of numerous studies in physics, biology and chemistry. For example, when asked, "What causes the seasons?" many college students explain that the *distance* between the earth and the sun is the primary cause (Bransford, et al., 2000). Similar misconceptions about cultural, sociopolitical, ideological, and religious content are just as common and often lead to naïve beliefs and misunderstandings of ethnic, racial and religious groupings.

The problem with misconceptions is that, left unchallenged, they may actually interfere with learning the concepts needed to master a particular subject (Bransford, et al., 2000). Think of misconceptions as filters allowing only the passage of information that fits our students' current knowledge structure and blocking out any information that conflicts with what they've previously learned. When this happens new information won't make any sense, it won't be remembered, and it won't be applied.

We need to pay attention to and make explicit the incomplete understandings, false beliefs, and naïve understandings of concepts that students bring with them to the learning process. To begin helping students overcome their misconceptions we must find out what students already know about the subjects we are teaching (Bruning, Schraw, & Ronning, 1995).

Assessing What Students Know (Or Think They Know)

Are you aware of what your entering students already know about your subject? If not, the assumptions you make about your students may be inaccurate, and may lead to an overestimate—or in some cases an underestimate—of students' prior knowledge and skills. Office hours, small group discussions with students, problem-solving activities and demonstrations are all effective ways of learning more about our students' background knowledge. But these activities often occur during the course of a semester and therefore may not supply information in time for you to uncover the beliefs that can block student learning.

Two simple techniques for gathering information on what students already know include the Background Knowledge Probe and the Misconception/Preconception Check (Angelo & Cross, 1993). Both techniques can be used as formative assessments by providing feedback on what students know (or think they know) in time for you to directly address their misconceptions.

Background Knowledge Probe

Background Knowledge Probes are simple surveys or questionnaires that include a few focused questions about concepts that students will need to know to succeed in your course. Asking questions of this sort can help highlight important concepts for your students as well as provide you important information about your students' knowledge and abilities.

These surveys are not hard to prepare. If you can write a good multiple-choice exam, you can develop a useful survey to assess students' background knowledge. And, the assessments don't have to be difficult to score—you only need a few questions to sample students' predispositions. A given Background Knowledge Probe may require students to write short answers, to circle the correct response to multiple-choice questions, or both. Here's a sample item from an introductory astronomy course:

As seen from your current location, when is the Sun directly overhead at NOON (so that no shadows are cast)?

- every day
- on the day of the summer solstice
- on the day of the winter solstice
- at both of the equinoxes (spring and fall)
- never from the latitude of your location

Source: *Background Knowledge Check-Astronomy Diagnostic Test (ADT)-M. Zeilik, University of New Mexico, Department of Physics and Astronomy.*

The correct response is "e".

When preparing questions to assess students' prior knowledge, begin by asking yourself the following questions: What misconceptions or preconceptions might be commonplace among students who take this course? Which of these are most likely to interfere directly with learning for the course? How can I deal with these misconceptions once they are identified?

Background Knowledge Probes can be used at the beginning of a course, at the start of a new unit or lesson, or prior to introducing an important new topic. Once collected and analyzed, the data can be extremely useful when planning subsequent sessions or units of the course (Enerson, Plank & Johnson, 2001). These classroom assessment activities can be done for credit, but it's usually best not to grade them. Instead, use them as a learning activity to help students find out what they're thinking. [See Background Knowledge Probe on page 3]

Misconception/Preconception Check

Another method for gathering feedback on students' prior knowledge is the Misconception/ Preconception Check. Its focus is on uncovering the prior knowledge or beliefs that may actually get in the way of students' learning. As such, the Misconception/Preconception Check can be especially useful in courses dealing with controversial or sensitive issues (Angelo & Cross, 1993). And, because it's an anonymous "survey," students are more likely to respond honestly rather than providing what they think you want them to say or with "safe" answers. Assessing and understanding students' stereotypes or preconceptions upfront will save you considerable frustrations in the long run. [See Misconception/Preconception Check on page 3]

Implications for Teaching

Simply telling students to stop thinking in a certain way will not dislodge their misconceptions (Enerson, Plank & Johnson, 2001). Instead, you can help students understand why those beliefs are inaccurate or incomplete by dealing directly with their preconceived assumptions and beliefs. Once misconceptions have been identified, you can help students develop more accurate understandings by encouraging them to question, describe, predict, explain, and justify their ideas. In the astronomy example presented earlier, students who believe that it's cold in winter because the earth is farther from the sun could be asked to develop an explanation that accounts for other facts such as the difference in seasons in the northern and southern hemispheres. Students might then be asked to compare, analyze, and justify their reasoning with their peers. The key to overcoming misconceptions is in helping students make their ideas explicit (Bransford, et al, 2000). Here are some additional suggestions for breaking through the fog:

- Ask students to construct representations or concept maps identifying the key concepts and then have them explain how each concept is related or connected
- Ask students to summarize or paraphrase each other's ideas
- Ask students to justify and evaluate their ideas
- Explain to students what you mean by "evidence"
- Teach students the *language* of your discipline
- Encourage guided small-group discussions and peer interactions
- Model metacognitive skills like self-monitoring ("Does this idea make sense?") and evaluation ("How useful is this idea?")

Summary

Taking a quick inventory of what students know about a subject area or concept *before* you begin teaching can benefit both you and your students. Ongoing assessments like the Background Knowledge Probe and the Misconception/Preconception Check not only reveal students' prior knowledge and the corresponding "holes" in their thinking, such assessments can teach students to be more aware of their thinking. They also allow students opportunities to track their progress over the course of a semester.

These Classroom Assessment Techniques are simple to use and can be easily adapted to most subject areas. The Teaching and Learning Center instructional consultants are available to help you design a Background Knowledge Probe or a Misconception/Preconception and to discuss the results of these and other formative assessment measures.

References

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Classroom Assessment Techniques (Angelo & Cross, 1993).

Background Knowledge Probe

Before introducing an important new concept, subject, or topic in the course syllabus, consider what the students may already know about it. Try to find at least one point that most students are likely to know, and use that point to lead into other, less familiar points.

Prepare two or three open-ended questions, a handful of short-answer questions, or ten to twenty multiple-choice questions that will probe the students' existing knowledge of that concept or topic. Phrase these questions carefully; vocabulary unfamiliar to students may obscure your assessment of how well they know the facts or concepts. Write your open-ended questions on the chalkboard, or hand out short questionnaires. Ask students to answer open-ended questions succinctly, in two or three sentences if possible. Tell your students that these surveys are not tests or quizzes and that will not be graded. Encourage students to give thoughtful answers that will help you make effective instructional decisions.

At the next class meeting, or as soon as possible, let students know the results, and tell them how the information will affect what you do as the teacher and how it should affect what they do as learners.

Misconception/Preconception Check

What are the most troublesome common misconceptions or preconceptions students bring to your course? Brainstorm this question with colleagues to generate your list. Select a handful those most likely to interfere with learning in your course and focus your Misconception/Preconception Check on them.

Create a simple questionnaire to gather information about students' ideas and beliefs in these areas. You can use a multiple-choice format or a short-answer format. Short-answer questions can uncover more useful information, but they compromise anonymity. Multiple-choice questionnaires are safer, and the responses are easier to analyze. To gauge how strongly held the beliefs are, use Likert-type scale responses.

Ask a colleague to read your questions to make sure they don't sound patronizing, threatening, or obvious.

Before giving the questionnaire to your students, think through how you'll respond to several likely outcomes. Strike any questions you're not prepared to deal with.

Explain your reasons for using the Misconception/Preconception Check. Make sure the anonymity of their responses is ensured, and announce when and how you plan to respond to their feedback.

About the author: Laurie Bellows earned her Ph. D. in Educational Psychology from the University of Nebraska-Lincoln (UNL) in 1994. In 2003, she joined UNL's Office of Graduate Studies where she coordinates the Graduate Student Academic and Professional Development program. She also facilitates workshops on a variety of teaching and learning issues. This article was originally published in *Teaching at UNL, Teaching and Learning Center Newsletter*, Vol., 23, No. 1, , 2001, Lincoln, NE: University of Nebraska-Lincoln.