higher-level thinking Questions

Mathematics

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EDUCATION

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Introduction

In your hands you hold a powerful book. It is a member of a series of transformative blackline activity books. Between the covers, you will find questions, questions and more questions! But these are no ordinary questions. These are the important kind—higher-level thinking questions—the kind that stretch your students' minds; the kind that release your students' natural curiosity about the world; the kind that rack your students' brains; the kind that instil in your students a sense of wonderment about your curriculum.

But we are getting a bit ahead of ourselves. Let's start from the beginning. Since this is a book of questions, it seems only appropriate for this introduction to pose a few questions—about the book and its underlying educational philosophy. So Mr Kipling's Six Honest Serving Men, if you will, please lead the way:

What? What are higher-level thinking questions?

This is a loaded question (as should be all good questions). Using our analytic thinking skills, let's break this question down into two smaller questions: 1) What is higher-level thinking? and 2) What are questions? When we understand the types of thinking skills and the types of questions, we can combine the best of both worlds, crafting beautiful questions to generate the range of higher-level thinking in our students!

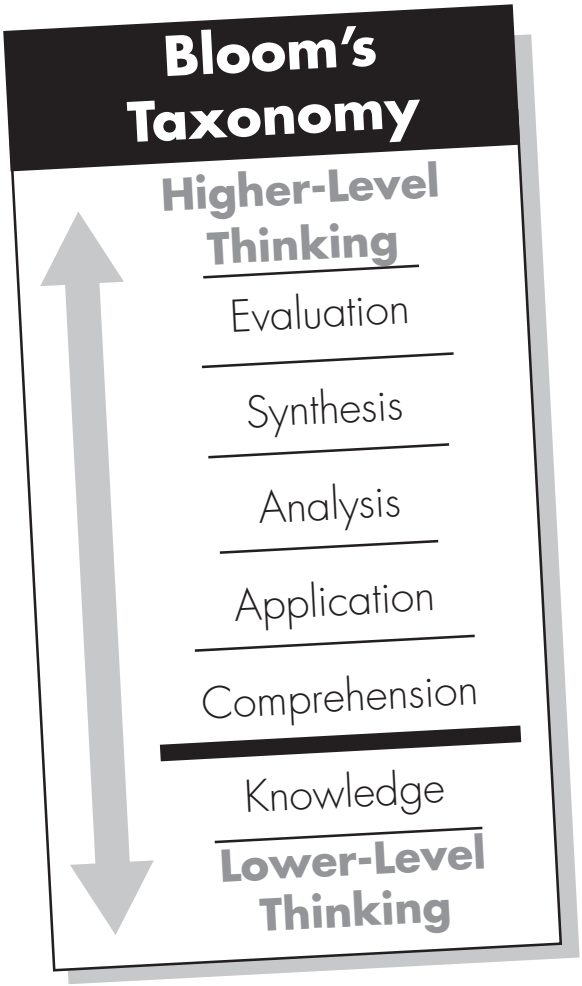
Types of Thinking

There are many different types of thinking. Some types of thinking include:

- **applying**
- **assessing**
- **associating**
- **augmenting**
- **comparing**
- **connecting**
- **contrasting**
- **decision-making**
- **defining**
- **drawing conclusions**
- **elaborating**
- **eliminating**
- **empathising**
- **evaluating**
- **experimenting**
- **explaining**
- **generalising**
- **inferring consequences**
- **investigating**
- **inventing**
- **making analogies**
- **memorising**
- **planning**
- **predicting**
- **prioritising**
- **problem-solving**
- **recalling**
- **reducing**
- **reflecting**
- **relating**
- **reversing**
- **role-taking**
- **sequencing**
- **substituting**
- **summarising**
- **symbolising**
- **synthesising**
- **understanding**
- **thinking about thinking (metacognition)**

This is quite a formidable list. It's nowhere near complete. Thinking is a big, multifaceted phenomenon. Perhaps the most widely recognised system for classifying thinking and classroom questions is Benjamin Bloom's Taxonomy of Thinking Skills. Bloom's Taxonomy classifies thinking skills into six hierarchical levels. It begins with the lower levels of thinking skills and moves up to higher-level thinking skills:
1) Knowledge, 2) Comprehension, 3) Application, 4) Analysis, 5) Synthesis, 6) Evaluation.
See Bloom's Taxonomy on the following page.

The taxonomy was revised in 2001 by Lorin W. Anderson and David R. Krathwohl to



incorporate new research into the framework. Based on the work of Benjamin Bloom, the changes to the taxonomy were in three broad categories; terminology, structure and emphasis. The most notable changes were:

• Bloom's six major categories were changed from noun to verb forms

• the lowest level of the original, Knowledge was renamed and became Remembering

• Comprehension was retitled Understanding

• Evaluation became Evaluating and moved down below Synthesis, which became Creating.

In education, the term "higher-level thinking" often refers to the higher levels of Mr Bloom's taxonomy. But Bloom's Taxonomy is but one way of organising and conceptualising the various types of thinking skills.

There are many ways we can cut the thinking skills pie. We can alternatively view the many different types of thinking skills as, well…many different skills. Some thinking skills may be hierarchical. Some may be interrelated. And some may be relatively independent.

In this book, we take a pragmatic, functional approach. Each type of thinking skill serves a different function. So called "lower-level" thinking skills are very useful for certain purposes. Memorising and understanding information are invaluable skills that our students will use throughout their lives. But so too are many of the "higher-level" thinking skills on our list. The more facets of students' thinking skills we develop, the better we prepare them for lifelong success.

Because so much classroom learning heretofore has focused on the "lower rungs" of the thinking skills ladder—knowledge and comprehension, or memorisation and understanding—in this series of books we have chosen to focus on questions to generate "higher-level" thinking. This book is an attempt to correct the imbalance in the types of thinking skills developed by classroom questions.

Types of Questions

As we ask questions of our students, we further promote cognitive development when we use Fat questions, Low-Consensus questions and True questions.

Fat Questions vs. Skinny Questions

Skinny questions are questions that require a skinny answer. For example, after reading a poem, we can ask: "Did you like the poem?" Even though this question could be categorised as an Evaluation question—Bloom's highest level of thinking— it can be answered with one monosyllabic word: "Yes" or "No". How much thinking are we actually generating in our students?

We can reframe this question to make it a fat question: "What things did you like about the poem? What things did you dislike?" Notice no short answer will do. Answering this fattened-up question requires more elaboration. These fat questions presuppose not that there is only one thing but things plural that the student liked and things that they did not like. Making things plural is one way to make skinny questions fat. Students stretch their minds to come up with multiple ideas or solutions. Other easy ways to make questions fat is to add "Why or why not?" or "Explain" or "Describe" or "Defend your position" to the end of a question. These additions promote elaboration beyond a skinny answer. Because language and thought are intimately intertwined, questions that require elaborate responses stretch students' thinking: They grapple to articulate their thoughts.

The type of questions we ask impact not just the type of thinking we develop in our students, but also the depth of thought. Fat questions elicit fat responses. Fat responses develop both depth of thinking and range of thinking skills. The questions in this book are designed to elicit fat responses—deep and varied thinking.

High-Consensus Questions vs. Low-Consensus Questions

A high-consensus question is one to which most people would give the same response, usually a right or wrong answer. After learning about sound, we can ask our students: "What is the name of a room specially designed to improve acoustics for the audience?" This is a high-consensus question. The answer (auditorium) is either correct or incorrect.

Compare the previous question with a low-consensus question: "If you were going to build an auditorium, what special design features would you take into consideration?" Notice, to the low-consensus question there is no right or wrong answer. Each person formulates his or her unique response. To answer, students must apply what they learned, use their ingenuity and creativity.

High-consensus questions promote convergent thinking. With high-consensus questions we strive to direct students ***what to think***. Low-consensus questions promote divergent thinking, both critical and creative. With low-consensus questions we strive to develop students' ***ability to think***. The questions in this book are low-consensus questions designed to promote independent, critical and creative thought.

True Questions vs. Review Questions

We all know what review questions are. They're the ones in the back of every chapter and unit. Review questions ask students to regurgitate previously stated or learned information. For example, after learning about the rainforest we may ask: "What percent of the world's oxygen does the rainforest produce?" Students can go back a few pages in their books or into their memory banks and pull out the answer. This is great if we are working on memorisation skills, but does little to develop "higher-order" thinking skills.

Education is not the filling of a pail, but the lighting of a fire.

— William Butler Yeats

True questions, on the other hand, are meaningful questions—questions to which we do not know the answer. For example: "What might happen if all the world's rain forests were cut down?" This is a hypothetical; we don't know the answer but considering the question forces us to think. We infer some logical consequences based on what we know. The goal of true questions is not a correct answer, but the thinking journey students take to create a meaningful response. True questions are more representative of real

Types of Questions

Skinny	**Fat**
• Short Answer	• Elaborated Answer
• Shallow Thinking	• Deep Thinking
High-Consensus	**Low-Consensus**
• Right or Wrong Answer	• No Single Correct Answer
• Develops Convergent Thinking	• Develops Divergent Thinking
• "What" to Think	• "How" to Think
Review	**True**
• Asker Knows Answer	• Asker Doesn't Know Answer
• Checking for Correctness	• Invitation to Think

life. Seldom is there a black and white answer. In life, we struggle with ambiguity, confounding variables and uncertain outcomes. There are millions of shades of grey. True questions prepare students to deal with life's uncertainties.

When we ask a review question, we know the answer and are checking to see if the student does also. When we ask a true question, it is truly a question. We don't necessarily know the answer and neither does the student. True questions are often an invitation to think, ponder, speculate and engage in a questioning process.

We can use true questions in the classroom to make our curriculum more personally meaningful, to promote investigation and awaken students' sense of awe and wonderment in what we teach. Many questions you will find in this book are true questions designed to make the content provocative, intriguing and personally relevant.

The box above summarises the different types of questions. The questions you will find in this book are a move away from skinny, high-consensus, review questions toward fat, low-consensus true questions. As we ask these types of questions in our class, we transform even mundane content into a springboard for higher-level thinking. As we integrate these question gems into our daily lessons, we create powerful learning experiences. ***We do not fill our students' pails with knowledge; we kindle their fires to become lifetime thinkers.***

Why?

Why should I use higher-level thinking questions in my classroom?

As we enter the new millennium, major shifts in our economic structure are changing the ways we work and live. The direction is increasingly toward an information-based, high-tech economy. The sum of our technological information is exploding. We could give you a figure how rapidly information is doubling, but by the time you read this, the number would be outdated! No kidding.

But this is no surprise. This is our daily reality. We see it around us everyday and on the news:

cloning, gene manipulation, e-mail, the Internet, Mars rovers, electric cars, hybrids, laser surgery, CD-ROMs, DVDs. All around us we see the wheels of progress turning: New discoveries, new technologies, a new societal knowledge and information base. New jobs are being created today in fields that simply didn't exist yesterday.

Virtually the only predictable trend is continuing change.

— Dr Linda Tsantis, Creating the Future

How do we best prepare our students for this uncertain future—a future in which the only constant will be change? As we are propelled into a world of ever-increasing change, what is the relative value of teaching students facts versus thinking skills? This point becomes even more salient when we realise that students cannot master everything, and many facts will soon become obsolete. Facts become outdated or irrelevant. Thinking skills are for a lifetime. Increasingly, how we define educational success will be away from the quantity of information mastered. Instead, we will define success as our students' ability to generate questions, apply, synthesise, predict, evaluate, compare, categorise.

If we as a professionals are to proactively respond to these societal shifts, thinking skills will become central to our curriculum. Whether we teach thinking skills directly, or we integrate them into our curriculum, the power to think is the greatest gift we can give our students!

We believe the questions you will find in this book are a step in the direction of preparing students for lifelong success. The goal is to develop independent thinkers who are critical and creative, regardless of the content. We hope the books in this series are more than sets of questions. We provide them as a model approach to questioning in the classroom.

On pages 10 and 11, you will find Questions to Engage Students' Thinking Skills. These pages contain numerous types of thinking and questions designed to engage each thinking skill. As you make your own questions for your students with your own content, use these question starters to help you frame your questions to stimulate various facets of your students' thinking skills. Also let your students use these question starters to generate their own higher-level thinking questions about the curriculum.

Who?

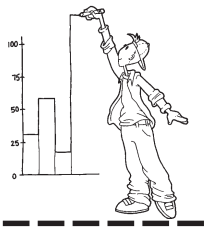
Who is this book for?

This book is for you and your students, but mostly for your students. It is designed to help make your job easier. Inside you will find hundreds of ready-to-use reproducible questions. Sometimes in the press for time we opt for what is easy over what is best. These books attempt to make easy what is best. In this treasure chest, you will find hours and hours of timesaving ready-made questions and activities.

Place Higher-Level Thinking In Your Students' Hands

As previously mentioned, this book is even more for your students than for you. As teachers, we ask a tremendous number of questions. Primary teachers average 348 questions a day. How many questions would you predict our students ask? Researchers asked this question. What they found was shocking: Typical students ask approximately one question per month.* One question per month!

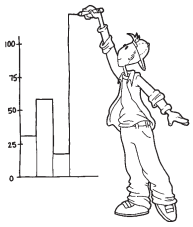
* Myra & David Sadker, "Questioning Skills" in *Classroom Teaching Skills*, 2nd ed. Lexington, MA: D.C. Heath & Co., 1982.



Data and Graphing
Question Cards

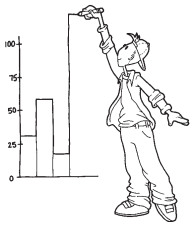
Data and Graphing

1 What questions can you ask yourself to decide which type of graph is best to display a set of data?



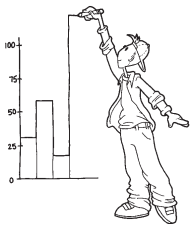
Data and Graphing

2 How are bar graphs and pictographs similar? How are they different?



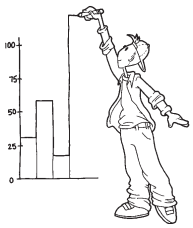
Data and Graphing

3 What are some situations for which you would display your data in a bar graph? In a pictograph?



Data and Graphing

4 What are the advantages and disadvantages of creating a graph out of a set of data?



Data and Graphing

Journal Writing Question

Write your response to the question below.
Be ready to share your response.

You have decided to graph something daily. What is it and why is it important to see graphically?

Data and Graphing

Question Starters

Use the question starters below to create complete questions.
Send your questions to a partner or to another team to answer.

1. What can data _____

2. How can different graphs _____

3. When a graph is displayed, _____

4. To collect data, begin by _____

5. How do patterns in data help _____

6. Which type of graph is best _____

7. In order to create a graph, you need _____

8. In what ways can data help _____