

# Howard **GARDNER** UNDERSTANDING



THE  
**LEARNING & MIND**  
SERIES

Instructor's Package

## **About this Guide**

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This guide is intended to assist in the use of the DVD *Understanding* for instructional purposes.

The following pages provide an organizational schema for the DVD along with general notes for each section, key quotes from the DVD, as well as suggested discussion questions relevant to the section.



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# **UNDERSTANDING**

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## **Summary:**

In **Understanding**, Howard Gardner delves into notions of understanding, the meaning of the scholarly disciplines, and the possibilities and challenges of interdisciplinary thinking. He explores how the disciplines (including their knowledge, skills, concepts, and methods) are applied in new situations to understand phenomena both familiar and strange.

## **Structure:**

**Part 1.** Disciplines, Performances, & Understanding

**Part 2.** The Unschooled Mind

**Part 3.** The Disciplined Mind

**Part 4.** MI Meets Understanding

**Part 5.** What Disciplinary Thinking is Not

**Part 6.** Interdisciplinary Thinking

**Part 7.** Understanding in the Digital Age

# Part 1. Disciplines, Performances, & Understanding

## Understanding as Educational Goal

- Beyond sheer memory, recall, information
- Understanding as a performance—for yourself and for others
- You understand when you can apply knowledge, skill, ways of thinking, methods appropriately in a new situation—if you can't apply it, the knowledge is of no use (Exception ☺)
- The crucial role of the disciplines

Gardner opens his presentation by recalling the time when, at the turn of the millennium, he was asked to name the greatest invention of the previous two millennia. His answer was classical music, and he jokes that he was hoping to be quoted widely. Today, Gardner suggests that his best answer would be that the greatest inventions of the previous two millennia are the scholarly disciplines. Gardner explains that the scholarly disciplines—among them math, science, history, and the arts—are major and essential ways of thinking that have been constructed over time, and that they are revelatory in their *departure* from common sense and intuitive human tasks. Gardner points out that academics and intellectuals often take the disciplines for granted, not considering that these fields were human inventions and, in fact, typically go *against* common sense.

Having laid this groundwork, Gardner clarifies the notion of “education for understanding.” Understanding is more than just having a good

## Examples of Disciplinary Understanding

- Apply political history to make sense of a current campaign for president
- Use economic theory to explain the onset and burst of the latest financial bubble
- Draw on knowledge of chemistry to probe the effects of fossil fuels on the earth’s atmosphere in our time
- Can evolutionary theory explain paradoxes of human behavior? If not, what can?

memory, he says; it goes beyond simple knowledge. Unless one tries to *explicate* a concept, one lacks a strong sense of one’s own level of understanding: We understand an idea when we can *apply* disciplinary knowledge, skills, methods, and ways of thinking to new situations in which we do not already know the “correct” answer. Exploring what it means to have understanding as a goal of education, Gardner says that we must go beyond sheer memory and recall; he suggests that understanding should be a *public* performance (an application of knowledge) for both ourselves and others. He offers examples of disciplinary understanding: applying political history to make sense of a current electoral campaign; using knowledge of economic theory to explain the onset and burst of a more recent financial bubble; drawing on knowledge of chemistry and ecology to explain the impact of fossil fuels on the environment; and using evolutionary theory to explain human behaviors such as generosity and altruism.

Discussion questions continued on next page.

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**Points for discussion related to this section:**

Discuss Gardner's assertion that the disciplines often go *against* common sense. What does he mean by this? Why might the development of something that goes *against* common sense be considered an accomplishment?

Consider the knowledge you are gaining through these presentations about a topic like multiple intelligences. How might you differentiate your *knowledge* of the material from your *understanding* of it? Give an example of how you might apply the knowledge you are gaining here to a new situation.

At the end of this section, Gardner offers several examples of disciplinary understanding. What other examples can you think of? What, for instance, would suggest disciplinary understanding of stem-cell research? Of online-privacy issues?

Imagine that someone in the media is asking you to name the greatest invention of the past two millennia—in particular, something that has changed the way we think. What might you come up with and why? What sorts of intelligence might it draw on, and how might various types of intelligence approach it?

## Part 2. The Unschooled Mind

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### Understanding in early life— Before School/Disciplines

- According to Jean Piaget, actions on the world are the infant and toddler ways of sensori-motor understanding
- By age 5, child has already developed functional theories and applications in many spheres of life—common sense and common non-sense
- But attaining literacy and disciplinary thinking—the major tasks of school—pose new challenges to understanding

In Part 2, Gardner explores how understanding develops: Long before children encounter the scholarly disciplines, they learn about the world through actions in the world, often with little or no help from adults. Gardner also points to the work of Swiss developmental psychologist and philosopher Jean Piaget, who noted infants' and toddlers' acquisition of a "sensorimotor" understanding of the world (also known as the sensorimotor stage of development). By age five, Gardner continues, the child has developed functional theories and applications in many arenas—in other words, a growing sense of both common sense and nonsense.

Gardner next explores some often used reasons for sending children to school—to give them a place to spend their days (so that adults can work), to develop interpersonal skills, to learn how one's country and the wider world work, and (most of all) to become literate and learn to carry out simple calculations. By learning the disciplinary ways of thinking, young people are able to understand the world not just through common sense and nonsense, but through the lenses and methods of those disciplines. Sure, says Gardner, there are more efficient ways to prepare young people for work than to send them to school until age eighteen; but the best—and perhaps the only—way to understand the world is to cultivate disciplinary habits of mind.

In exploring how challenging this can be, Gardner points out how powerful the unschooled mind really is—and notes that many of a typical five-year-old's beliefs are very difficult to eradicate. This phenomenon is encapsulated in Gardner's term "cognitive Freudianism," which refers to Jean Piaget's emphasis on children's theories and Sigmund Freud's emphasis on the persistence of early relationships.

### Cognitive Freudianism

In nearly every individual there exists  
the mind of a five year old child  
struggling to get out.

Through this set of beliefs, Gardner explores the arrival in a child's mind of powerful intuitive theories of matter (as expressed in physics), mind (as expressed in psychology), and life (as expressed in biology). The following are examples of those early theories:

Matter: If you continue to divide something into smaller and smaller pieces, eventually there is nothing left.

Life: If something is moving, it's alive; if something is not moving, it's dead.

Mind: People who "look like us" are good and those who do not "look like us" are bad—a primitive and powerful drive that is common around age five.

Intuitive Conceptions  
Powerful Engravings  
Theory of Matter  
Theory of Mind  
Theory of Life

Because these early theories are so powerful and so difficult to supplant, Gardner calls them “engravings.” Our job as educators is to help students pick up more sophisticated ways of thinking—historical, philosophical, scientific, artistic, logical, and so on.

Gardner continues with further examples of common misconceptions—many of which are widespread even among people with prestigious educations and relevant expertise:

When asked whether, when each is dropped from an equal height, a feather or a ball will hit the ground first, many students fail to take into account fundamental laws of mass and gravity; they answer that the ball will hit the ground first.

Among graduating students at Harvard University and MIT, many of those asked why the weather (in the US, at least) is warmer in summer than in winter replied that summer is warmer because the earth is closer to the sun. (In fact, this phenomenon has to do with the tilt of the earth’s rotating axis.)

And in social studies, humanities, and the arts, we often follow scripts or stereotypes—typically featuring forces of good combatting forces of bad. (The French Revolution is a classic example in which one party or the other is uncritically vilified.) This persistent habit sheds light on the difficulty of taking more complex ways of thinking (historically, politically, economically, etc.) and applying them to current situations.

## The Point

For the unschooled mind—both common sense and common nonsense-- we don't need school or formal education!

Gardner concludes this section with the gentle warning that there is no easy way to put on the lenses of a disciplinarian. Yet the disciplines may be the most effective and penetrating way to understand the world as completely as possible. Concluding this section of his talk, Gardner offers three elements of understanding:

Understanding is a performance, in which we test whether our explanations “hold water.”

The disciplines are arenas for understanding; without them, our understanding is primitive.

Understanding is difficult to achieve.

Discussion questions continued on next page.

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**Points for discussion related to this section:**

Think of a field in which you have some measure of expertise. What is a common misperception about that ability or topic? Why might people frequently have this misperception? What type of discipline or intelligence are they failing to bring to bear?

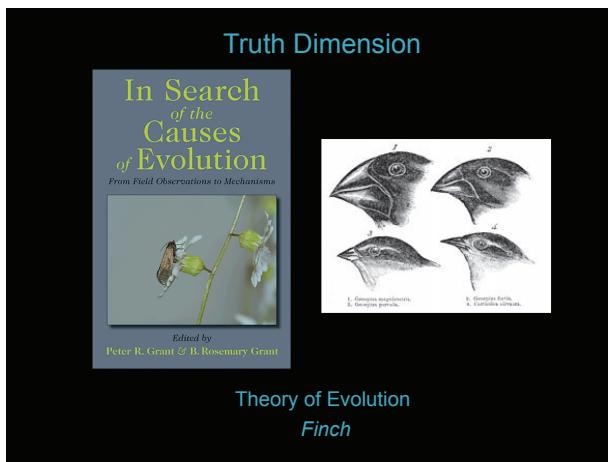
Gardner notes that as children develop, they become increasingly able to understand the world through the lenses of disciplines. Are there ways in which this new knowledge might obscure common sense or “nonsense” in unfortunate ways? What does the value we place on the disciplines tell us about our cultural values? Our personal values?

Give an example of “cognitive Freudianism.” What childhood experiences might challenge that belief and how might they be insufficient to change it?

Consider the idea of scripts or stereotypes. Come up with an event or era from history to which you bring the common script of good vs. bad. How might you examine this example in a more complex way?

What scripts do you bring to your own life? What forces do you see or feel consistently? How accurate are the ways you habitually look at the past, and how would you describe the ways you habitually imagine the future? Are there disciplinary habits of mind that might revise any scripts that seem flawed?

## Part 3. The Disciplined Mind



Gardner opens Part 3 of his talk by urging educators to decide what is truly important in a discipline (as we can't cover every event or work of art); to decide to spend time on these chosen topics, *uncovering* them rather than simply covering them; and to take advantage of our (and our students') multiple intelligences.

Gardner next explores the themes of his 2000 book, The Disciplined Mind, in which he uses three case studies to examine the dimensions of truth, beauty, and goodness—all in the service of achieving disciplinary understand by going deeply into a few focal topics. To probe the notion of truth, Gardner looks back at the story of Charles Darwin's finches, and Darwin's observation that on different islands in the Galapagos, finches had differently shaped beaks. Eventually, Darwin arrived at an ecological answer, noting that the different types of beaks enabled the finches to survive in varied conditions. Gardner sees this as a generative topic that can help us in understanding biology more broadly. In unpacking ideas of beauty, Gardner turns to Mozart's "The

Marriage of Figaro," using one aria as an entry point to the love triangle while also introducing people to classical music. In delving into the dimension of morality, he examines the Wannsee Conference, a 1942 meeting of senior Nazi officials at which the "final solution to the Jewish question" seems to have been agreed upon—and gives us insight into how historians piece together the past. Through these three stories—those of the finches, "The Marriage of Figaro," and the Wannsee Conference—Gardner

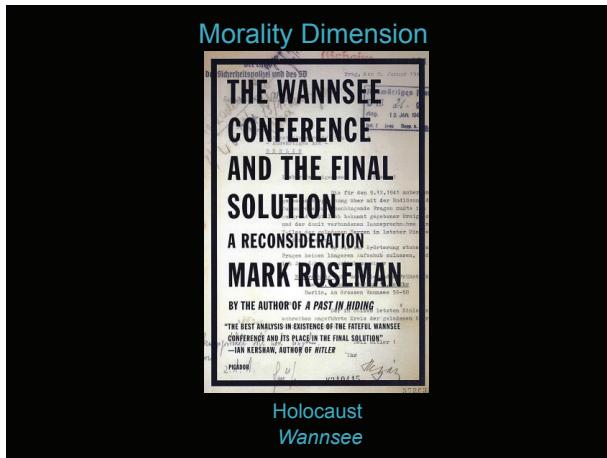


explores the disciplinary methods of science, art, and history, examining how these fields have explored questions such as: Why do finches need different beaks? How can we explicate Mozart's love triangle? How, in the absence of decisive documentation, do historians figure out what happened in the past?

Through stories and questions such as these, Gardner suggests we can show how experts in various fields wrestle with problems and develop the disciplinary tools to come up with good answers.

Finally, Gardner offers four components of teaching for understanding:

- 1. Generative ideas or essential questions:** For example, how did it happen that a group of men in 1942 decided on the “final solution”?



- 2. Understanding goals:** In history, an understanding goal is an appreciation that any event is open to

numerous interpretations and yet we can order their likelihood. In science an understanding goal is that correlation is not causation. Performances of understanding: For example, what would an evaluator take as evidence that if someone understands one thing, they understand another? And how can one use their understanding of one event to illuminate another event?

- 3. Performances of understanding:** These are responses to questions that indicate whether or not the student has understood the underlying concept. For example, a student evinces a performance of understanding if he or she can indicate which results in an experiment are merely correlational and which indicate causality.

- 4. Ongoing assessment:** In this system, an educator talks about goals and performances from her first day with students, continually offering students opportunities to perform their understanding and discuss the ways in which they are learning.

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### Points for discussion related to this section:

Consider the case studies that Gardner chose for his book *The Disciplined Mind*. Why might Darwin’s finches make an especially useful example for the study of truth? Why might “The Marriage of Figaro” be particularly useful for the study of beauty? And why might Gardner have chosen the Wannsee Conference as a way to examine the study of morality? Feel free to do additional research as necessary to get background on each of these topics.

Discuss what it means to “perform understanding.” What advantages and risks might come with a requirement to perform one’s understanding in front of others? What advantages and risks might come with performing that understanding in solitude?

Consider the four essential components of understanding that Gardner enumerates in this section—including rich and generative questions, a sense of what understanding entails, an idea of how one might *perform* understanding, and ongoing assessment to probe students’ level of comprehension. How might you apply these components to Gardner’s presentations? In other words, what might you come up with in terms of rich questions, ideas of what understanding entails, ways to use that understanding, and assessment of understanding?

Discuss possible “generative ideas” for a study of the following phenomena: the digital revolution; the genetic revolution; interdependent economies; the rapid spread of brands and fads.

## Part 4. MI Meets Understanding

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In summarizing his theory of multiple intelligences, Gardner offers the metaphor of having several computers in one's brain, each uniquely suited to contribute to the investigations of The Disciplined Mind:

**Narrative/linguistic:** One can tell stories about Darwin and the HMS Beagle, "The Marriage of Figaro," or the Nazi era.

**Quantitative/logical:** The study of finches concerns the size of different populations on different islands; music is filled with numbers and ratios; and much of the story of World War II concerns different populations and what happened to them. Each of these involves logic as well: How does one thing lead to another?

**Existential:** In Darwin's work, we might consider the question of what it means to be alive; with "The Marriage of Figaro," we might ask why we admire certain works of art; and in studying the Wannsee Conference, we inevitably wonder why people do terrible things.

**Artistic** (musical and spatial): Each phenomenon—evolution, the love triangle, and the Holocaust—can be explored through works of art.

**Hands-on** (bodily/kinesthetic): To explore Darwin's theories, we might recreate species and allow them to compete for resources, either physically or on a computer screen; to inhabit "The Marriage of Figaro" in a new way, we might sing and play variations on different instruments; to feel the weight of the

Holocaust, we might create an experience along the lines of a Holocaust museum for children in which, upon entry, the children each receive a picture of a child living in 1939, and on exit, they learn what happened to him or her during the war.

### MI and Understanding

- Individuation— Each person has the opportunity to learn in comfortable ways and to display the learning comfortably
- Pluralization— presenting powerful ideas in multiple ways--- reaches more students and exemplifies what it means to understand a concept

**Interpersonal/collaborative:** Students might reenact (and expand on) any of these three phenomena through role play and interaction.

Almost anything worth teaching, says Gardner, can be approached in myriad ways that draw on our multiple intelligences. By making this variety one aim of teaching, an educator makes two things happen: One is the process of individuation, which offers people the opportunity to learn and to demonstrate their learning in ways that are comfortable for them; the other is the process of pluralization, which entails presenting important ideas to students in multiple ways, whether narrative, quantitative, aesthetic, existential, hands-on, or collaborative (and, in the process, modeling the kind of interdisciplinary thinking that is key to thorough understanding).

## Obstacles to Education for Understanding

- Short-answer assessments
  - Text-test context
- Correct answer compromise
  - Pressures for coverage
- Regression to “common sense” and “common nonsense”

Despite the promise of these techniques, Gardner says there are obstacles. One comes in the form of short-answer assessments; one involves the tendency to test only what is within the context of a given text (“text-test context”); one, called the “correct-answer compromise,” stems from the educator’s habit of not pushing his students, in the hope that they will not push him back; one comes with pressures for wide-ranging and necessarily superficial coverage of topics; and the final one is the risk of falling back on formulae rather than wrestling with new phenomena.

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### Points for discussion related to this section:

How and why might taking multiple approaches to a topic enhance someone’s understanding of it?

Going back to the topics Gardner describes from his book The Disciplined Mind, discuss what type of approach (logical, kinesthetic, quantitative, hands-on, etc.) might be the most appealing and/or most intuitive for you to learn about finches, “Figaro,” and the Wannsee Conference. What type of approach would be difficult for you to learn, and why?

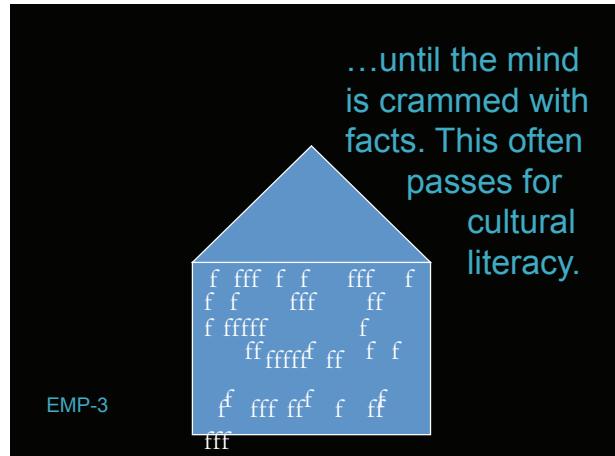
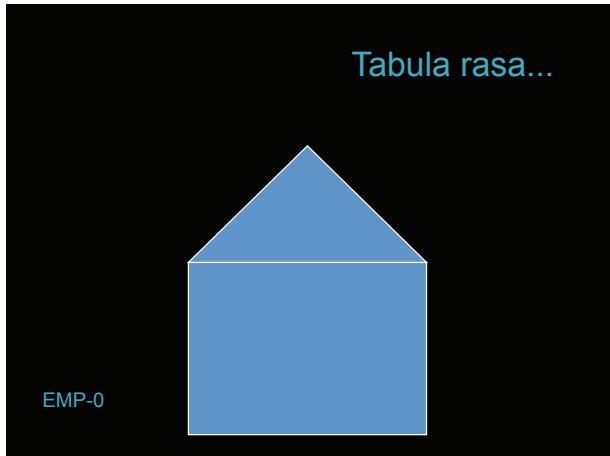
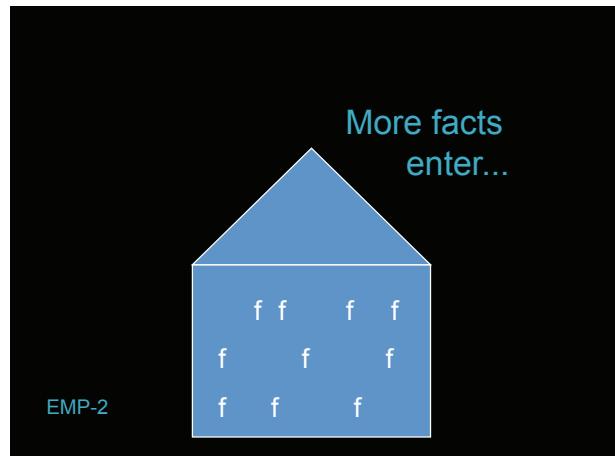
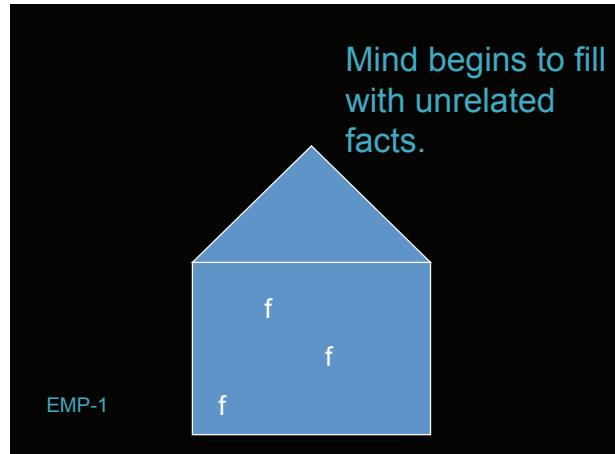
How might standardized tests be considered an impediment to individuation and/or pluralization? Can you think of any testing format that would make room for these styles of teaching?

What advantages and dangers might there be in habitually giving students a choice of methods for learning? Do you believe students should be able to always choose their mode of learning, or have certain modes of learning enforced?

## Part 5. What Disciplinary Thinking is Not

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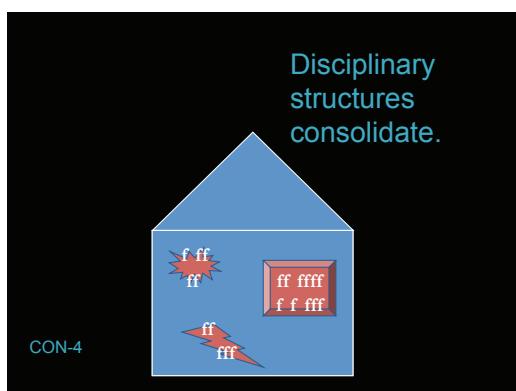
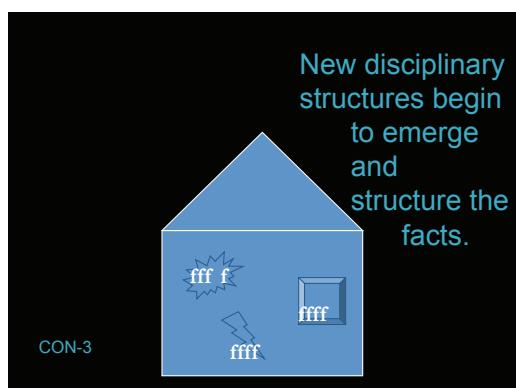
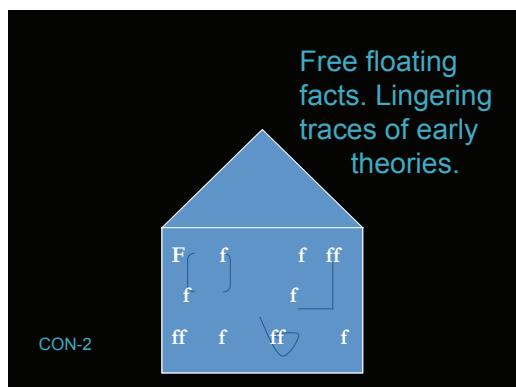
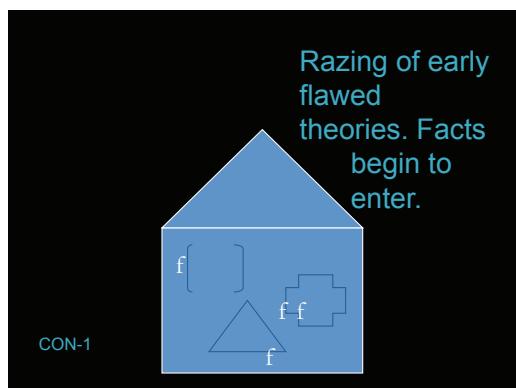
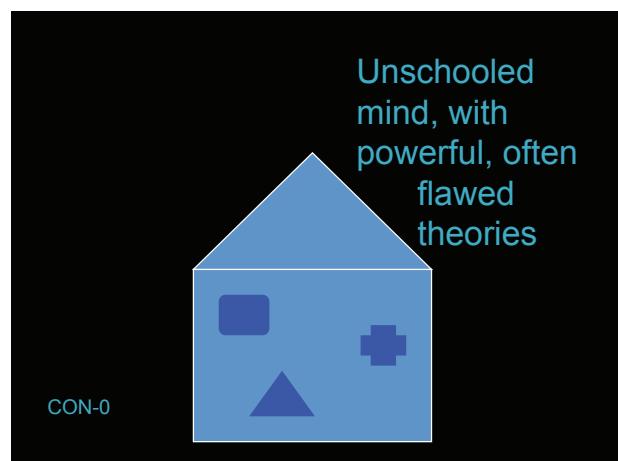
In demonstrating his idea of what disciplinary understanding is *not*, Gardner brings up the metaphor of the “empiricist barn.” He describes the empirical approach to education as one supposing that we begin with an empty barn (or *tabula rasa*) and try to put as much information into (or on) it as possible. The accumulation of those facts then passes for cultural literacy.



In place of this “empiricist barn,” Gardner advocates for the notion of constructivism in the tradition of psychologist Jean Piaget and philosopher John Dewey. According to this school of thought, the unschooled mind is *not* a blank slate or an empty barn; rather, we develop powerful (and flawed) theories on our own from an early age. Our minds become disciplined as we notice discrepancies between our theories and our worlds, and are forced to revise (or raze) those theories. Eventually—and here, Gardner points to the mind of a seven or eight year old—those free-floating facts drift among the lingering fragments and traces of our early theories. As new disciplinary structures emerge, we begin to array these facts in meaningful structures to understand the differences between fact and fiction, faith and evidence. Finally, those disciplinary structures begin to consolidate and, with mastery of multiple disciplines, interdisciplinary work becomes possible.

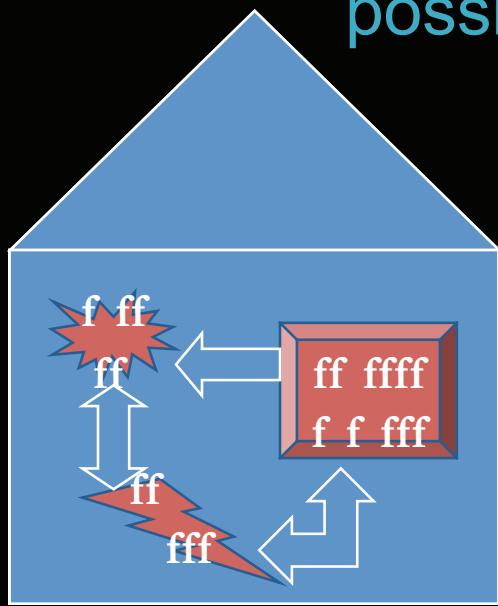
The crucial element here, says Gardner is deep immersion: One can never get to disciplines simply from knowing lots and lots facts.

## CONSTRUCTIVIST BARN



Interdisciplinary  
work now  
possible.

CON-5



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**Points for discussion related to this section:**

What does Gardner mean by his metaphor of the “empiricist barn”?

Consider how Gardner’s idea of the growth of the mind matches up against his metaphor of the “empiricist barn.” What other metaphors might you come up with for what Gardner describes as the development of the “disciplined” mind?

How do Gardner’s ideas of this process of learning line up with or against the way you have previously conceptualized knowledge and understanding?

Discuss whether and how, with the accumulation of disciplinary structures, interdisciplinarity is inevitable.

## Part 6. Interdisciplinary Thinking

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### Topics Requiring Interdisciplinary Study

- Globalization (good or bad?)
- Stem cell research (pros and cons)
- The state of the environment
- The power of telecommunications
- Immigration, multiculturalism, racism

Maybe: What you think about in the shower or argue about at the dinner table or ‘tweet’ to your admirers...

In this final section, Gardner examines the accelerating demand for interdisciplinarity and breaks down that phenomenon into several factors. The broadest of these is globalization, which, Gardner says, has ushered in a new era of thinking; in an increasingly globalized world, an ever-greater amount of work is problem-based (the environment, immigration, stem-cell research, etc.) and necessitates input from many disciplines. Gardner points to the proliferation of universities and independent research centers that require interdisciplinarity and even put that synergy at the core of their mission; he also notes the explosion of knowledge and the resultant need for synthesis of that knowledge—a synthesis that relies on expertise from several fields.

### Interdisciplinarity 101

- Begin with neighboring disciplines: math-science; history-literature; music-visual arts
- Problem-based learning, with guided use of disciplines
- Projects that benefit from multiple disciplines
- School wide themes, that can be approached via common sense, but also proto- or genuine disciplinary methods and concepts
- Synthesizing courses, like International Baccalaureate’s “theory of knowledge” capstone

Gardner suggests beginning the practice of interdisciplinarity by coordinating “neighboring disciplines”—math and science, history and literature, music and the visual arts. Projects that demand contributions from multiple disciplines will accustom students to interweaving their ways of thought, as will “synthesizing courses,” such as those on the theory of knowledge. As another example of this orientation, Gardner points to schools that promote interdisciplinarity via school-wide themes (the rainforest, the Civil War, immigration, etc.).

Problem-based learning, so that you draw on sciences and social sciences; and projects that benefit from multiple disciplines. School-wide themes (for example, the circus, an upcoming holiday, an election, or friendship) can be approached through children’s common sense, through proto-disciplinary ways of thinking, and through synthesizing courses—thus, illustrating various ways of thinking.

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**Points for discussion related to this section:**

Discuss how globalization might be forcing or guiding individuals to think in a more interdisciplinary way.

Why might Gardner suggest that we begin to think in an interdisciplinary way by interweaving the methods and concepts of “neighboring disciplines”? Why these disciplines?

Gardner notes that this is an optimal and urgent moment for interdisciplinary understanding. Can you think of other moments in history that might have been considered essential times for an interdisciplinary view? Are there moments in history when interdisciplinary viewpoints—had they been more predominant—might have changed the course of events? When and how?

## Part 7. Understanding in the Digital Era

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### The Challenge

In a digital era, you can't postpone or suspend interdisciplinarity, it is everywhere from the beginning... is there any 'dry land' on which to construct understanding?

In opening the final section of his presentation, Gardner asks: How does understanding look in the 21<sup>st</sup> century? He warns that in the digital era, one cannot postpone or suspend interdisciplinarity—it is everywhere, and it is upon us from the moment we first encounter the Internet with its slew of information on all subjects and from all sources. We are thus thrown into what Gardner calls "the interdisciplinary bath" from an early age; continuing the metaphor, he suggests we must learn not to drown, and we must do that through attaining some foundation in the disciplines. Without some disciplinary skills, the proliferation of information is especially daunting—indeed, without the ability to question, organize, and sift through information, it can be hard to know what to pay attention to.

### Understanding in the Digital Era

- Limitless amounts of information are available
- Much of it is unsifted, unreliable, transient
- Sticking to a single discipline is very difficult
- You can advance at your own pace
- You can work with others, nearby and far away
- You can try out your understandings in multiple media, formats, activities

On the positive side, though, one can flourish amid new ways of learning, advance at one's own pace, and work alongside others or far away from them. Some aspects of understanding in the digital era make understanding both more complex and easier, and multiple intelligences allow us to try out understanding in multiple formats and through a wide range of activities.

In concluding his second presentation, Gardner emphasizes *understanding* as a key goal of thought and of life. Without disciplinary understanding, time in school is not well spent. We must *perform* our understandings, he says, challenging ourselves to examine questions in different ways. A disciplinary understanding demands the application of appropriate concepts, skills, methods, and ways of thinking to a range of complex problems. And those disciplinary ways of thinking must be brought to bear on problems and puzzles with no obvious answers. This process, says Gardner, opens up new possibilities for understanding.

Gardner predicts that as time goes on, the world will belong to those who understand well—the biological world, the physical world, the principles of economics, the historical procedures and imagination—and that for those without a strong foundation in the disciplines and even in interdisciplinary ways of thinking, life will be increasingly difficult. Here, Gardner challenges one traditional idea of education—that the purpose is to master facts and basic skills, and to be evaluated through tests. Against this idea, he puts forth his own notion of the goal of education: guiding students toward an understanding in and across the disciplines, with evaluation designed to give students something new and ask them to make sense of it—in other words, to perform their understanding.

In closing, Gardner ponders: What might happen as we bring brains and computers ever closer together? Will we ultimately hand over the disciplines to the digital world? He asserts that the disciplines are what separate us from barbarians—and calls out for us to value the disciplines, interdisciplinarity, and the delicate and complex process of mastering both.

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### **Points for discussion related to this section:**

Discuss Gardner's assertion that understanding is a key goal of life. What do you take this to mean? What types of understanding are most important to you?

Gardner suggests that one traditional goal of education has been to help students master facts and basic skills, and to evaluate those students through tests. How has your education lined up against this standard? If your education followed this model, how has it worked (and not worked) for you? If your education did not follow this model, how did it differ, and how did it work (and not work) for you?

When Gardner asserts that in time, the world will belong to those with strong skills in understanding, what do you think he means? How might the world belong to these people? Are there people who, on the surface, might *not* have strong skills in understanding, but still in some sense “own” the world? Are there ways to fit these people into Gardner’s theory?

Consider Gardner's final questions: What might happen as we bring brains and computers ever closer together? And will we ultimately hand over the disciplines to the digital world? What answers do you pose to these; what theories do you offer? What disciplines do you feel you are bringing to these answers?

# The unschooled mind: why even the best students in the best schools do not understand

by Howard Gardner

I'm very honored to have been invited to give the Peterson lecture to gathered representatives of the IB Organization. I must confess that I didn't even know about the IB until a year or two ago. It was my loss and my ignorance but everything that I've learned about it, has intrigued me and I think you have a convert on your hands. (Addendum in 2003: By now I know a fair amount about IB, have studied the Theory of Knowledge Course, and am an unabashed fan).

I'm a developmental psychologist and Geneva is in fact a special place for me. Twenty five years ago I married a developmental psychologist and we decided to launch our honeymoon by coming to Geneva. We met and shook the hand of Piaget.. At the time I knew that I would study cognitive development but of course could not anticipate what I would have to say about developmental psychology in the future. I have had a very lively career over the last 25 years during which I challenged Piaget on several issues because I felt he was very central to my work and I admired him. My three arguments with him were as follows.

First of all, Piaget believed that if you studied children you had to know what they were going to become - what the end state of development is. Piaget thought it was to be a scientist; that's what Piaget was. However, in my own training I had spent a lot of time working in the arts. I felt that there was something wrong with a theory which only talked about the mind of the scientist as being the end-all of a child's development. So I began to explore what development would be like if one thought of participation in the arts as an artist, or a critic, or a performer or a connoisseur as being a viable end state for human development. This is not to say that human beings should develop to become artists any more than they should develop to become scientists but rather that we can develop many different kinds

of human beings.

The second argument I had with Piaget, and the one that I became infamous for, was against the notion that there was a single thing called intelligence which could be measured by an intelligence test. Now it's not widely known that Piaget studied in Alfred Binet's laboratory. Binet was dead but the laboratory was still there under the direction of a psychologist named Théodore Simon who had worked with Binet. Piaget became interested in children's minds because of the mistakes the children made on the intelligence tests. Binet was a great scientist, credited with the creation of the IQ test. I do not blame him for any of the abuse done in the name of intelligence and intelligence testing. Binet's ideas affected an American named Lewis Terman who in 1916 created the first normed standardised intelligence tests. For ever afterwards psychologists assumed that they could establish how smart somebody was, and in fact what intelligence is, by giving a test which took an hour or so.

In fact, some people now give the QT (the quick test) which just takes four or five minutes. Why spend an hour if you can test intelligence in four or five minutes? Those of you who are from the United Kingdom, will doubtless recognise [shows a picture] Hans J. Eysenck, the world's most famous psychologist. He used to be a great defender of intelligence tests until this "hair dryer" [picture] came along with 18 electrodes attached to it. Mr. Eysenck and his friends now believe that if you simply put this beanie on a person's head and look at the brain waves for a few seconds, you can tell how smart that person is. Well, I think that the mind and the brain are much more complicated than that and thanks to a project in which I became involved over 10 years ago, and where I had the pleasure of meeting Leo Fernig [of UNESCO], I developed a quite distinctive way of thinking about intelligence.

The way that I define intelligence is the ability to solve a problem, or to make something, to fashion a product which is valued in at least one culture or community. That may not seem like an exotic definition to those of you who are not psychologists, but in fact it is not consistent with what most psychologists believe. Psychologists think solving problems is important, but they shy away from any concern in making something, writing essays, staging plays, designing buildings, because you can't assess that in four or five minutes, or with a beanie. Moreover psychologists get very upset when you talk about an ability being valued in a culture; that is because it suggests that, unless a culture provides certain opportunities, a person might not seem to be smart. What should be disturbing to everybody in this room is that most psychologists believe that intelligence is completely in the brain ... and if you know exactly where to stick the thermometer with a dipstick you can figure out how smart that person is.

My view of intelligence, which I'm not going to expand on today, says intelligence is always interaction between potentials and what's available in a culture. For example, Bobby Fischer is one of the greatest chess players in the history of the world. But if Bobby Fischer had been born in a culture where there was no chess, he would just be, to use a technical term, a schlemiel [idiot] because he had a brain that was perfectly matched to something in his culture, namely chess but mismatched to just about everything else.

Anyway doing a fairly elaborate analysis which is described in a book called "Frames of mind", I eventually argued that there are 7 different kinds of intelligence. I'm not going to run through them because that would be another lecture. It is worth pointing out, however, that Piaget thought he was studying **all** of intelligence. But I believe he was studying logical, mathematical intelligence (later in his life, I think he came to the same conclusion about the focus of his own work) whereas I talk about intelligence which artists have as well as those which are in the human sphere - something which I think

is a great concern to you as you begin to deal with global issues, moral issues, issues of value and the like.

My third argument with Piaget - the deepest one and the one I want to talk about today - had to do with the most interesting claim that he made. If you remember anything from your studies of Piaget, you will remember that he maintained that children pass through stages of cognitive development. So infants know the world in one way, five-year-olds in another way, ten-year-olds in another way, and fifteen-year-olds in still another way. Part of this developmental sequence is that when you go from nine to eleven or from thirteen to sixteen years not only do you see the world in a very different way, you can't even remember how you used to see the world.

So at age seven you don't believe that you ever thought that if a ball of clay was squished, there was less clay there; or that if water were poured into a different kind of vessel, there will be more or less water depending on the shape of the vessel. Yet every four-year-old in the world believes that. Anyway I'm not going to argue that Piaget's demonstrations were wrong because many of them were more correct than wrong. Where Piaget was wrong, I believe, was in his argument that, when people get older, they see the world in a different way and they no longer have access to earlier ways of knowing. In fact, I'm going to argue that most of us, except in areas where we are expert, continue to think the way we did when we were five years of age. We continue to think the way we did before we went to school. That's a pretty radical thesis, and I decided I was not going to pre-judge the IB schools. Maybe you are exceptional in that you have succeeded in extinguishing the less productive aspects of the five year old mind. I hope we will have time to discuss that after my talk.

So, my talk is on the subject of education for understanding. If I said to you: what *is* understanding and *how* can we determine whether understanding has been achieved? - that is a much more difficult question.

I am going to define understanding as the capacity - knowledge, skills, concepts, facts - learned in one context, usually the school context, and used in a new context in a place where you haven't been forewarned that you should make use of that knowledge. That's what understanding is. If you were only asked to use knowledge in the same situation in which it was introduced, you might understand, but you might not; we can't tell. But if something new happens out in the street or in the sky or in the newspaper, and you can draw on your earlier knowings, then you understand.

In my book, "The Unschooled mind", I have a section on the 1991 Gulf War which provided brilliant examples in America of not understanding at the highest levels. In history, in political science, in economics and in physics, there were rampant examples of misunderstanding. I will not go into that now. Instead, I'm going to introduce my "problématique" with three quite common sense examples.

In the first five years of life children all over the world, with very little formal tutelage, learn to speak, to understand, to tell stories, to tell jokes, to draw, to sing, to invent new tunes, to engage in pretend play - all the things which Piaget and other psychologists demonstrated. Even though nobody knows how to teach these things, kids learn them all. Then they go to school and suddenly, in the very place where we are supposed to know how to teach them, it's very hard and many of them don't do well. That's a paradox. That's an enigma.

Vignette number two.

Students at the very best universities in the United States (places like MIT and Johns Hopkins), with very high grades in physics, leave their class and are given a problem to solve on the street, or a game to play, which involves various physical principles. Not only do they fail to use what they learned in school but they actually answer in the same way that five-year-olds do, or for that matter in the way pre-Aristotelians and Aristotelians did.

Let me use an example. Ask almost anybody what happens, what forces obtain when you flip a coin. Most people will come up with the following answer (even people who have taken physics courses): you've got a certain amount of force in your hand and you transfer that force to the coin; for a while that force makes the coin go up and then, when the force kind of gets spent, the coin is tired and kind of flips to the ground. (Now, I'm not a physicist so I believe that account, more or less). However, physics friends tell me that the second you release the coin, the only force that obtains on the coin is gravity; that's the only force that's working.

However, that goes against a very powerful theory that you develop when you're young. And it's not that theory that's abandoned, it's Newton's and Galileo's laws of motion that prove very difficult to master.

Vignette number 3 is a personal one. I've a daughter, a very nice girl and a very good student. She graduated Phi Beta Kappa from a very good American college. She called me up when she was a sophomore in college, crying on the telephone. I said: "why are you crying?" She said, "it's my physics; I don't understand it." I said: "well, you know (and I was telling the truth) I really respect you for taking physics because it's difficult and I wouldn't have taken it in college." And I didn't take it in college. I then lied to her and said: "I don't even care what grade you get, but it's really important that you understand your physics." So I said: "go to your instructor and have him or her explain to you what it is you don't understand." And she said: "Dad, you don't get it! I've never understood."

This had a profound impact on me. My daughter was not saying that she was a faker or a "poseur". What she was saying is what I think most of us experience: we know the moves to make in school, to get good grades and even to be successful, but we know that if people put the questions to us in another way, if they push to see how much we have really understood, the whole house of cards might fall. That's what she was saying.

At least in the United States, there are great obstacles to understanding.

**Short answer assessments** or what I call a “text test context”. You read a text book. The test is based on the text book and the text book tells you the answers you have to give.

**The correct answer compromise** is an “entente” between the teacher and the student. If you respond this way, nobody should ask any further question. No one is made uncomfortable, but deeper understanding is avoided.

**The pressure for coverage** which means: there are 37 chapters in the book and you must get through all 37 chapters.

So, we have three vignettes. The young child learns so easily; the school child has difficulty. The students who get “As” at the best universities in the world are still Aristotelians in their models of the physical world. And then, of course, the most powerful evidence of my daughter. What’s going on here? This is the answer. I call it cognitive Freudianism.

Freud convinced people that, as adults, we continue to have the same personality traits as when we were children. We fight the same battles we fought with our parents and our siblings. Most people who live in a modern western society believe this. (If you don’t believe it and you pay me US\$100 an hour, I will convince you that it’s true.) That’s what psychoanalysis is all about. I’m making the claim that Freud was correct in an area that he wasn’t expert in, but that Piaget was. Namely, except in areas where we are experts, most of us continue to think the way we did when we were five years of age.

An expert is a person who comes to understand the world differently. But that is very, very difficult to do and I’m going to argue today that it’s not done very often. This is the thesis of the talk.

Later on, I’m going to give you evidence that no matter where you look in the curriculum, you will find students who don’t understand: physics,

mathematics, biology, literature, art. It’s ubiquitous. Then when I get two thirds into the talk, I will tell you that there are things we can do about it. It’s not hopeless. It is possible to educate for understanding.

But now, I’ll do something that’s going to take about ten minutes. When I met Patricia Davidson [chair of the IBO Examining Board] in the airport in Zurich, I said to her: “is this lecture ceremonial or should I deal with real content?” She said: “Make them work hard, make the interpreters work hard and make the audience work hard.” So what I’m going to do now is give you a fairly technical description of why it is so difficult to go beyond the five-year-old mind.

My analysis has 3 foci which I have introduced to you already. There is the young natural learner: that 3, 4 or 5 year old who speaks so much about the world without formal tutelage. There is a student in most schools who basically masters what school requires so he or she can get to the next level. But I will argue he doesn’t really understand. Then there’s the individual we want: the person who can use knowledge in new situations. That’s my definition of an expert.

There is a form of knowing (theory of knowledge) that goes with each of these 3 foci. The expert is a person who can use the skills that are valued in his or her culture in context. So when an historical example comes up, he can draw on history; when a physical example comes up he can draw from physics, and so on. That’s what we want; that’s why we go to school. If people are not going to be able to use the knowledge we may as well close schools down. Scholastic knowledge is what we are very good at doing in school; but unless that scholastic knowledge can be activated in new circumstances it remains inert and essentially useless..

We teach people notations, squiggles on a paper like some of you are doing, formal concepts - what is gravity, what is density, what is force. People who have no sense of what it’s like in the world can give you a formula and a definition if that’s what is called for in class. Then, if you’re lucky and you attend

an IB school, you get epistemic forms. Epistemic forms means how the people think in the different disciplines because to think like a historian is not the same as to think like a literary critic or a biologist. (This, I have subsequently learned, is the focus of the Theory of Knowledge course).

So that's what school is supposed to do. But in the first years of life a natural learner benefits from what Piaget so brilliantly described: sensory motor knowledge, learning about the world, using your hands and your eyes, exploring the world of objects, the world of liquids poured from one container to another and what I call first order symbolic competence. People use words, pictures, gestures, to communicate meanings. That's what every five-year-old can do.

That's the good part. However, five-year-olds do one thing which is troublesome: they form intuitive conceptions or theories - theory of matter, theories of mind, theories of life. Every normal five-year-old develops these theories. And it's very good for getting along in the world. However, the theories are wrong. School is supposed to replace the erroneous theories with better theories.

So what's a theory of matter? A theory of matter is: if I have a heavy object in this hand, a light object in this hand and I release them at the same time, the heavier one will fall more quickly. That's what you learn intuitively. Heavy things fall more quickly. However, Galileo went to the tower of Pisa, dropped two objects, and since then we understand that that's not in fact what happens. We understand that the laws of acceleration are independent of weight. But as children we develop a very powerful theory of matter and that's very hard to shake.

Here's a theory of life: every five-year-old believes if it's moving it's alive; if it's not moving, it's dead. This is a very useful theory. However it doesn't help for sleeping dogs, and computers are a real problem. Are computers which display moving images alive or dead? It's very hard to say.

A theory of mind is very relevant to what I've heard talked about with my new acquaintances here in the world of IB. I've got a mind; you've got a mind. If we look the same our minds are the same. If we look differently, our minds are different. If you look like me, you've got a good mind; if you look differently, you've got a bad mind. This is a very powerful theory which is very well entrenched. It shows up in all kinds of places. Just turn on the television for evidence. It's this that education is supposed to deal with, and it's this, I maintain, that education has, by and large, failed to deal with. These are just again the scholastic acquisitions.

Why does this happen? I claim it happens because there are different kinds of constraints operating on us.

The first one has to do with the kind of species we are. We learn certain things very easily. We develop certain theories very readily, and other ones are very, very hard for us to develop. It's a whole interesting evolutionary question why that should be the case.

There are institutional constraints. If you put 50 people in a room like this and one person in front of them, it's very hard to explain things so all 50 people can understand; for every person who is nodding, three are nodding off.

There are also disciplinary constraints. As I said, the moves that have been developed over the centuries for analysis in one discipline are very different from the moves in other disciplines. Physical causality is not like historical causality or literary causality.

So, those are constraints which contribute to the problem I am describing.

Anticipating what we might do, there is some hope. The hope lies in two institutions. One of them is very old: the apprenticeship. There are many powerful clues about how to educate for understanding contained in the apprenticeship. The other is a new institution, more familiar in the United States than in most other countries, but it is spreading rapidly: the children's museum, or the science museum, or

the discovery museum, or, for those of you who have been to San Francisco, the *Exploratorium*. There are very powerful education implications in those two institutions.

What follows is an attempt to summarise this very technical argument.

The natural learner displays what I call intuitive understanding. He or she is very promiscuous with the theories already developed in the young mind. Whenever anything happens, the young child draws on the theories of mind, matter and life, to explain them, whether or not those theories are appropriate at all.

The scholastic learner never tries to apply the theory anywhere, except where he or she is told to. It's exactly the opposite. So, the scholastic learner gives a ritualised performance. The teacher asks the question, the student gives the prescribed answer or they are told that they are wrong, and you go on to the next student. The disciplined learner, the expert, produces a discipline of understanding, which means, not only can he or she draw on knowledge when it's appropriate, but equally important, doesn't draw on that knowledge when it's not appropriate. The five-year-old is too promiscuous and uses it always. The ten-year-old is repressed (the opposite of being promiscuous) and never uses it. But the person with disciplined understanding has good taste and uses the knowledge just when it's appropriate. This comes about because there are constraints, also gaps.

What I've tried to do is to say that there are some deep, if you will, some epistemological reasons, why it's very difficult to teach for understanding.

What I want to do now is to take a "Cook's Tour" of the different disciplines to show you that this isn't a problem just for somebody else's discipline; it's a problem for every discipline.

I've already mentioned physics. Most people remain five-year-olds or Aristotelians even though they studied physics. Here is a wonderful example, actually

from astronomy; some of you may have seen this film. Twenty-five Harvard students have just graduated, all wearing their gowns and their mortar boards. An interviewer says to the students: "Tell me, why is the earth warmer in the summer than it is in the winter?" Twenty-three out of the 25 students immediately came up with the same answer, the answer which you would come up with if you didn't know what I was lecturing about: namely that the earth is closer to the sun in the summer than it is in the winter. Now if we think about it, that doesn't make any sense because it wouldn't account for the seasons in different parts of the world. The right explanation has to do with the angle of the world on its axis as it spins around. But 23 out of 25 students forgot to apply what they have learned in their astronomy classes and give the same five-year-old kind of answer.

You might say physics is hard. How about biology? Perhaps biology is much easier? Research shows that students who have taken not one, but two or three courses in biology focusing on the topic of evolution, still do not understand the basics of evolution. They still believe that something in one generation can be passed on to the next, even if it was acquired in that generation. They are also still perfectionists. They think that each organism is trying to get more perfect and there is an unseen hand that's guiding that perfection rather than simply variation and selection within a particular ecological niche. So problems in physics extend to biology and to the other sciences as well.

What about mathematics? Mathematics is all abstract. It has nothing to do with the real world. So maybe people don't have misconceptions in the area of mathematics. What they have instead, is what I call rigid algorithms. They learn to fill in numbers into a formula.

This is the problem. There are six times as many students as professors. If there are ten professors, how many students are there? Anybody wants to risk an answer? I guess the answer is no. Anyway, that is quite a simple problem. The answer is 60. If I ask

you to capture the above information in a written equation where S stands for students and P stands for professors, most people will write the following equation:  $6S=P$ . This is because if you parse the sentence it says there are six times as many students as there are professors. However what they are actually writing is “six times sixty equals ten” which is clearly an absurd result.

What happens in mathematics is that students learn how to plug numbers into formulas, how to solve equations. As long as the information is presented to them in a certain canonical order, they will get the answer right. If, however, the problem is presented in a new way, in a way which actually describes understanding of the formalism, most people will not get it right because they will not understand the formalism.

I can think back to my own education. I studied the quadratic equation and I must have solved 500 problems with the quadratic equation. I’m sure by the time I finished school, I could do the quadratic equation in my sleep. Never did anybody give me any education of what a quadratic equation stood for. Nowadays if I ran into a problem I wouldn’t have a clue that it involved the quadratic equation, even though I might, on a dark and stormy night, remember what a quadratic equation was. But I got very good grades in mathematics because I wasn’t expected to know where to use this kind of formalism.

So, the problem in science is misconceptions. The problem in mathematics is rigidly applied algorithms

How about in the arts, in the humanities ?

In the arts and the humanities the problem is different. It’s what I call scripts or stereotypes. Early in life children develop very powerful theories about the world. A favourite script is the restaurant script. Every four-year-old knows that if you go to a restaurant, somebody comes and seats you. You are given the menu; you order. Food comes. You eat it and then you call for the cheque, and you leave.

If you go to McDonalds you pay first but that’s an exception to the script. Every four-year-old also knows about birthday parties: who comes, what you serve, that kind of thing. The rules are different in different cultures but everybody knows about birthday parties.

Another script which you develop when you are very young is the Star Wars script—named both after the movie and after President Reagan’s strategic defence initiative. Star Wars says: it’s good to be big; you should be big yourself; if you’re not big, align yourself with somebody who is big. If you look like that person, you will be good and people who look different will be bad. That’s the Star Wars script and it’s very very powerful!

You can have people who’ve studied world history and you ask them about the causes of the first world war, and they say: “Oh, it’s very complicated. There was colonialism, imperialism, ethnic strife and long term rivalries” and they give you a very nuanced response. Then you say to them: “Well, what’s happening in the Gulf?” They will say: “Well, there is this bad guy named Saddam Hussein and if we get rid of him, everything will be OK.” Now, that’s a Star Wars type of explanation and, as I hinted before, it was very widely used in my country. In fact, we like to use Star Wars wherever we can in America.

In 1986 the bad guy was Muammar Kaddafi; in 1988 it was Manuel Noriega. (We got rid of him, but the problems remained; in fact, they got worse.) In 1990 it was Saddam Hussein and in 1992 I think it was Bill Clinton, but he won so we had to find somebody new! But it’s a very powerful way of thinking and you find it in social studies.

Actually, the best example of the unschooled mind in the arts comes out of the university of Cambridge in the UK. In the 1920s a literary critic and poet named I.A. Richards did a study of Cambridge undergraduates. He published it in a book called “Practical Criticism.” He took Cambridge undergraduates who were the best and brightest literary students. He gave them twelve poems and he

asked them two questions about the poems:

- **What do they mean ?**

- **Are they any good?**

He performed one manipulation on the poems. He removed the names of the poets. (It's like going to the Louvre without the labels, right?)

What did he find? He found that the students didn't have a clue about which poems were good (according to the critics) and which were bad. They rejected John Donne. They rejected Gerald Manley Hopkins. They embraced a Sunday poet who couldn't get into the "Cambridge Chronicle" and, when they were asked what accounted for the quality, they replied: if a poem rhymed, scanned, dealt with a pleasant subject, but not too sentimental, it was good. But if it dealt with philosophy or anything tragic or anything abstract, it was bad. So, here you have very, very good students who have studied literature, who, when the book clue is removed (namely this is by a good poet, this is by a bad poet or by a non poet), display the same kind of taste that someone with no education in literature would exhibit.

So, what I've tried to do now in part two is to argue that in every area of the curriculum you have real problems which reveal how difficult it is to educate for understanding. You have misconceptions in the sciences, rigidly applied algorithms in mathematics and scripts and stereotypes in social studies, humanities and the arts. Well, this is the end of the bad news part of the talk. We now move into a mode where I'm going to try to say that there is some hope after all. As I said, one source of hope is in taking some lessons from the old institution of apprenticeships and the new institution of children's museums.

Now, I want to be very clear about this point. People usually misunderstand me to say that we should institute seven year agreements between the apprentice and the master where the apprentice is indentured and has to sweep the floor and that kind

of thing, or that we should close schools down in an Ivan Illich sense and put everybody in children's museums. That's not what I mean.

What I mean is that there are very powerful educational messages in these two institutions which I think can help educate for understanding. In the case of the apprenticeship, a young person works for someone who is the master of his or her discipline or craft, and who uses that discipline or craft every day in the course of genuine problem solving. The master poses the problems and requires products from the apprentice at his or her level of competence; when the apprentice becomes more competent then the standards are raised.

The master never has to take kids and test them at the end of the week, or the end of the year because, essentially he and the student are assessing every day. Moreover the master embodies the learning that he or she wants the child to have.

So, in the United States, every teacher can read and write but very few of our elementary school teachers actually *do* read and write. In fact, in a very alarming statistic, the average American school teacher reads one book a year. People who live in a literate world who read and write and talk about what they are reading and writing will have youngsters who do the same. People who simply say you should read but turn on the TV for seven hours give a very different message.

As far as the children's museum is concerned this is a very new invention. Basically, until 25 years ago, there were almost no children's museums. But these are places which contain very lively demonstrations of many of the principles that students learn about in school, across the curriculum. They allow children to explore those principles, those ideas, at their own pace and in ways that are comfortable for that child. Frank Oppenheimer, who founded the *Exploratorium* in San Francisco, said: "Nobody flunks museum." It's a very powerful idea.

I became a devotee of children's museums because

when I took kids to children's museums I often found that kids who were called bright in school could not find their way around. They were very unschooled. But kids who were not considered bright in school could often learn very well in those contexts. I will explain later why that's very important.

For each of the areas of the curriculum, in which I have diagnosed a problem, I believe there is a move that we can make as educators which can be very helpful.

In the case of misconceptions, in the celebratory year 1992 I recommend Christopherian encounters, named after Christopher Columbus. If you believe the world is flat, but every day or every year you travel around the world and you come back to where you started before, that tends to belie the notion that the world is flat. In a Christopherian encounter you expose your theories to disconfirmation. If your theories are consistently disconfirmed, you will slowly abandon them, and hopefully construct a better theory.

Most American school kids, probably most school kids everywhere, believe that the reason that you are warm when you put on a sweater, is because that sweater has warmth in it. If every year, in school during the winter, you put a sweater outside and you come in the morning and find it is freezing cold, that tends to disconfirm the notion that there is warmth inherent in the sweater.

Christopherian encounters have to happen over and over again. To use an analogy which I used when I spoke with the interpreters about my talk, what I believe is: think about the brain with a mind as a surface which, earlier in life, becomes very much engraved with these primitive theories. What school usually does is simply to put some powder over that engraving so you can't see it. And as long as you're in school, the powder is what you notice. When you leave school, and you slam the door, the powder puffs up and the engraving is still there, the early theory. What happens in the Christopherian encounter is that you slowly upgrade that early engraving and you put

a new and better one.

But you can see that it doesn't happen in one time. Let me tell you what's wrong with the "one time" thing. If you ask my son Benjamin, who is now all of seven years, what's the shape of the world, he will tell you it's round. This makes you think he's very smart. But if you asked Benjamin where he is standing he will say: "That's easy. I'm on the flat part underneath." His theory has been totally unaffected but he has learned the powder that is required: namely, if you want to shut up your father, you say that the world is round because that's what grownups say, but who could believe it?

Thus Christopherian encounters challenge those notions every day.

In mathematics, the cure for a rigidly applied algorithm is what I call rich exploration of the relevant semantic domain. What that means in English is that you must know what the equation stands for. You have to understand the formalism. So if you are going to do distance, rate and time problems - a common algebra exercise - you do a lot of experimenting. You try to predict how long it will take for something to get from one point to the other. You develop an intuition for the formalism so that when you learn the formalism it actually refers to something that you already have an intuition for, that you already have an understanding for.

This has been done quite brilliantly with calculus where, before any of the formalism is introduced, kids learn to make predictions about their bodies moving at various speeds and what kind of graphs would be produced over the course of time, and things like that.

A mathematician is not somebody who remembers all the formalisms. A mathematician is somebody who doesn't care if he remembers because, if necessary, he/she can derive it again because he/she understands what it stands for. That's why most of us are not mathematicians.

In the case of the humanities, the cure for stereotypes

is the regular adoption of multiple stances. If it becomes a regular habit of mind to look at things from many different points of view, you will gradually abandon stereotypical thinking.

During the Gulf war, my older son went to school where there were kids from many different countries. The teacher had a very good idea. Rather than everybody just giving what the cable news network reported, he had a student from Iran, and a student from Kuwait, and a student from Israel, etc., give their understanding of what was happening every day. Then, a few weeks after that, the teacher asked the kids in the school: "What do you think Moshe will think about this and what do you think Omar will think about this?" That's giving students the opportunity to put themselves into other people's minds.

If you study any revolution, from the point of view of the vanquished as well as the victors, you get a very different story. If you study the American revolution from the point of view of the British, where it was a colonial uprising, and from the point of view of the French, where it was a good opportunity to get at the British, it's a very different story than if you just read the average American text book. That's how you break down stereotypical thinking, but it has to be a regular habit of mind, otherwise it won't work at all.

Well, you might say this is all very good and just what I would expect of a Harvard professor: lots of theory. I actually do a lot of empirical work, but that's another story. However, I am going to describe, as we get to the close of my presentation, a new project that I'm involved in which is actually designed to educate for understanding.

It is based upon three core ideas which I have worked out in conjunction with some colleagues at Harvard:

1. The identification of rich, generative ideas; nutritious topics on which it's worth spending a lot of time;

2. The development of different kinds of teaching languages - multiple ways to approach those topics, so we can be sure that students have maximum access to those ideas; and

3. What I now call "ongoing assessment."

"Ongoing assessment" (which I used to call "assessment in context") means assessment is taking place all the time by students and by peers as well as by the teacher.

We believe that if you can identify rich ideas, explore them in multiple ways and give students much opportunity to assess their own learning, that there is a chance for education for understanding.

I now want to flesh those ideas out because they are very abstract.

First of all, the greatest enemy of understanding is **coverage**. I said that earlier. If you are determined to cover everything in the book, you virtually guarantee that very few students will understand. So, if you want to educate for understanding you've got to make tough choices about what to focus on. And obviously you should focus on those things which have the biggest mileage. If you're teaching a course in history or social studies and you decide, say, to focus on democracy, or if you're teaching a course in biology and you choose to focus on evolution, you can cover a lot of the important material in those subjects by focusing on those topics. It will mean, however, if you're doing history you're not going to get through every decade. If you're doing biology, you're not going to get through every cycle or through every part of the cell, or every part of the tree. It's a hard choice, but we think it's a choice worth making. If you have rich concepts and you spend time on them, you can approach them in different ways.

Growing out of my theory of multiple intelligences, I claim that almost any topic which is worth spending time on can be approached from at least five different “windows” into the same room.

1. Narrational - basically the story mode
2. A quantitative, logical rational way of dealing with numbers, principles, causality
3. What I call a foundational way, asking very basic kinds of questions such as: Why is this important? How does it relate to what came before? How is it related to today?
4. Aesthetic, what does it look like? What does it sound like? What appearance does it make? What patterns and configurations? How does it impress you?
5. Finally, hands on: What is it actually like to be this thing, to do this thing? If you're studying evolution, what is it like to breed drosophila? If you're studying democracy, what's it like to be in a group that decides by consensus as opposed to one that decides by autocracy, oligarchy or some other political principle?

There are two advantages of using these multiple entry points.

First of all, you're more likely to reach every child, because not every child learns most easily in the same way. That's one of the burdens of the theory of multiple intelligences, which you've been spared today, but I believe that kids have different ways of learning.

Second of all, equally important, if you approach a topic from many different vantage points you're modelling for a student what it is like to be an expert. Because an expert is always somebody who can represent knowledge in more than one way. No expert only can think about his or her topic in one way. Experts have very flexible ways of thinking about their topics and that's what you're modelling as a master to your apprentices if you approach a topic in

a number of different ways.

That leaves assessment.

In what we call authentic assessments, we get very far away from short answer examinations which are particularly a plague of the USA to what I call performance-based exams where you actually demonstrate what it is that you're supposed to be able to do. Only in the USA would there be a conviction that, if you want to know how somebody can write, rather than ask him to write, you ask him to fill in the blanks. But other things which you've heard of - projects, exhibitions, portfolios and what I call “process folio” which is not just your finished work, but actually your drafts and you're thinking *en route* to fashioning a product - are good ways of assessing whether the students are really understanding.

In the work that we are doing on this project on understanding we work with teachers in local schools and we ask them first to define what we call “understanding goals” - these are the broad things that we want to achieve in a course. They will be very familiar things to you, like having a sense of the scientific method or understanding something about the nature of revolution.

What we then do, which may not be so familiar to you, is we define a whole family of “understanding performances” - these are performances which, if a student can carry them out, will count as evidence for understanding.

This is a play with language, but I think it's an important play, because people tend to think of understanding as something that happens in the head. We say, maybe it does but we don't know whether you understand unless you can perform your understanding publicly. So, your performance involves analyses, critiques, debates, projects that you create, exhibitions that you put on, things like that.

Finally, given the “understanding goals” and the “understanding performances,” how are those performances going to be assessed? And, as I think

is the case with IB, you make the assessment criteria absolutely clear. People know exactly what they are going to have to be able to do in order to perform an understanding. There are no surprises, no mysteries, no key to the answers, but rather examples all around of what a good performance is and what are not such good performances, from apprentice level all the way to that of a master.

Now I'm going to make an interesting kind of confession to you. I've talked about this stuff for a while and I've researched it for a long time, but, like many other professors, I never actually used it in my own teaching. Last year, I decided to do an experiment with my students who are even more privileged than I.A Richard's Cambridge undergraduates - these are Harvard graduate students. I took my Harvard graduate students in the basic course in cognitive development where they study Piaget, Bruner, Vygotsky and people like that, and I tested them three times during the course of the year: in the beginning, in the middle and at the end. I tested them for two things: their mastery of content and their understanding in terms that I have defined today. Could they use what they were learning in the course to explain new situations? - things in the newspapers, vignettes which I brought in, and so on. The results were quite shocking!

Imagine a graph in your mind - this is good, this is bad, this is over the course of the year; you can reverse them. In content, the students went steadily up. They knew very little content in the beginning, a fair amount in the middle and were very good at the end. They were good students. They are Harvard students. But you know what happened to the understanding? Absolutely flat. And not a ceiling effect, but a floor effect. They weren't very good in the beginning, they weren't very good in the middle, they weren't very good at the end. There were a few exceptions, just like there are few exceptions everywhere, but even at Harvard, they don't necessarily understand what their professors are teaching!

So fortunately, we got a grant (that's always what

you should try to do when you have a negative result) and this year, we're going to try to teach for understanding. It's going to be very different. I hope the results will show we're successful. But if not, we'll just keep doing it again, because obviously it's very important for students to understand.

I'm going to finish with a number of thoughts that I have had during the past year. Little epigrams which summarise the things that are important to me.

First of all, after working for 25 years in the area of psychology I realised that I've been interested primarily in two things. One is how to observe students carefully, and multiple intelligence theory is a way to look at students more carefully. The other is how to observe student work more carefully - and that is done by having assessment that looks at student performances very carefully.

I don't know how it is in your schools but I can tell you that in most of the schools that I visit, not much time is spent watching the students and developing a model of how particular students learn; not nearly enough time is spent looking at student work. I will give you a few more examples of that. This is what I call the teacher's fallacy. I succumbed to it for 20 years. I taught a great class, therefore the students understood. It's rather Cartesian isn't it? I teach, therefore you understand. The only way you can find out if students are understanding is to actually have them do some work.

One thing which has become very popular in the USA is the minute paper. At the end of the course, and every session, you ask the student to write down one thing that he or she learned in the period and one question that they have. It's a revelation! I never cease to learn when I do the minute paper. And the misconceptions are of course what's beautiful. They are wonderful misconceptions but unless misconceptions get out in the open they sit there underneath that powder. Portfolios are great! But I don't have time to look at my students work! I'm too busy, too much pressure for coverage, too many faculty meetings. I've a second job.

If you don't have time to look at students' work, the unfortunate conclusion is you shouldn't teach. Because, if you don't look at your student's work, you have no idea whether they are learning anything. I used to think that, if we simply change the assessment, everything else will be fine.

Because in the United States we typically have terrible assessments. I did realise that you can have wonderful assessment. But if the curriculum isn't good, the assessment is worthless. You can have wonderful examining boards sitting here in Geneva but if the curriculum isn't adhered to or hasn't been made up yet, it's worthless. I'm sure you have had experience with that. You can have wonderful assessment and curriculum but if the staff isn't developed, teachers aren't educated even before or during the experience, the assessment and curricular are worthless.

There is also something which I have to deal with and I think you have to deal with as well even if all these things are in place: if people don't really want to have that kind of education, it's not going to work out.

We now come to my last slide which says: "school doesn't have to be the way you remember it."

Unfortunately, the unschooled mind even applies to parents and teachers; they have a stereotype formed by the age of five about what school is like. Namely, somebody in front of the room talking like me, and they're sitting in their seat, trying to be quiet and all the knowledge is in my head and the purpose is to put it into your head.

That's a very powerful idea. Whether people love school or hate school, they all have that stereotype.

Unless we can help people think differently about what school can be like, what can be studied, how it can be taught, how it can be learned, then the opportunity for education for understanding is not going to be seized.

Now Piaget said one valuable thing which I didn't adhere to. He said that developmental psychologists should not try to be educators. And he steered clear of ever having any educational theory. I have stepped into the lion's den today and given you an educational theory that comes out of developmental psychology.

I did say, I didn't know whether it would resonate with those of you working in IB because maybe all of your students, all of your teachers, do understand. But, if so, I'd like to hear how you do it and if not, I will be happy to work on the problem together with you.

(transcript 16 June 2003)