

I can only show you the door; you're the one who has to walk through it.

Morpheus to Neo in the movie, *The Matrix*

UNIT 1: WHAT THIS BOOK IS ABOUT

- 1 About the Book
- 2 Finding Things out
- 3 White Crow on the Balcony
- 4 What Do These Examples Show?

1 About the Book

This book is titled 'Inquiry and Critical Thinking.' You might be wondering:

What do the words 'Inquiry' and 'Critical Thinking' really mean?

What would I learn from this book?

Of what value would that learning be for me?

Let's find out.

First, what is Inquiry?

When an examiner or an interviewer asks us a question, they expect us to give an answer using facts or procedures that we have learnt. For example, if someone were to ask us what the boiling point of water is, our memory would tell us that it is 100 degrees centigrade.

Suppose someone says: "Take a rectangular room 12 meters wide and 15 meters long. What would its area be?" A quick mental calculation would tell us that it is 180 square meters because we know the formula for the area of a rectangle, and we know how to do the necessary calculation.

Now, consider these questions:

- *For storing drinking water, should I use a glass jar or a plastic jar?*
- *What genetic factors allow migrating butterflies across generations to return to the same location year after year?*

If you don't know the answer, but would like to find out, what would you do?

We are talking about a situation where we:

- don't know the answer to a question;
- can't make calculations to get the answer;
- can't find anyone who knows the answer; and
- can't find an answer on the Internet.

INQUIRY is the process of looking for an answer through one's own thinking and discussions with others.

Inquiry is not to be confused with **ENQUIRY**, which is asking for information, as in:

I enquired after their health.

I made an enquiry at the counter.

In such cases, we would have to rely on our ability to think and figure out a good answer. Inquiry is the process of looking for an answer through thinking — either on one's own or collectively with others.

India's new National Education Policy (NEP 2020) talks about the need for students to develop 'higher-order cognitive abilities'. This brings up some questions.

What exactly are *higher-order cognitive abilities*? How do they relate to *inquiring*, *thinking critically*, and *solving problems*?

To cognize is to know.

Cognitive abilities are abilities related to knowing.

The **process of inquiry** seeks to know, so it is a cognitive process.

Higher-order cognitive abilities are inquiry abilities.

To help you find answers to questions like these, the book is dotted with conversations between:

- ❖ Rafa: a 14-year-old student
- ❖ Samira: Rafa's mother
- ❖ Anu and Neel (twins): Rafa's classmates
- ❖ Ila: Anu and Neel's mother, and
- ❖ Sanju: Anu and Neel's neighbour.¹

As you read, imagine that you are Rafa. Whenever Samira asks a question, stop reading, imagine that she is asking you (Rafa), and before you read

¹ The children call her Sanju *didi*. '*Didi*' means 'older sister' in Hindi and other languages of Northern India, but the term is used broadly to refer to an older girl or woman to indicate respect, and also as a term of endearment.

further, try to answer the question. That would be a good way to learn to figure things out yourself.

Let us listen to a conversation between Rafa and Samira.

2 Finding Things Out

Rafa: Mom, I just read a newspaper report about a new policy for education in India. It recommends that education should develop higher-order cognitive skills. What does that mean?

Samira: Yes, I too read that report. ‘Higher-order cognitive skills,’ eh? I think we need to unpack this systematically.

First, let's find out what *cognition* means. That will help us figure out what *cognitive skills* are. Then, we can look for what is special about *higher-order cognitive skills*.

Rafa: Okay, so what is cognition?

Samira: If I were not at home today, what would you do to find out?

Rafa: Hmm...I don't know.

Samira: Would you ask someone who knows, or look up the word *cognition* on the Internet, or try to find out by thinking through, or try a combination of these?

Rafa: So you're not going to tell me. Okay, maybe I'll do an Internet search.

Samira: We'll talk again after you've done your search, then.

Rafa found two entries for *cognition* on the Internet:

“... the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.”

(<https://en.wikipedia.org/wiki/Cognition>)

“... the states and processes involved in knowing, which in their completeness include perception and judgment. Cognition includes all conscious and unconscious processes by which knowledge is accumulated, such as perceiving, recognizing, conceiving, and reasoning.”

(<https://www.britannica.com/topic/cognition-thought-process>)

(The *Wikipedia* entry described cognition as a mental action or process. The *Britannica* entry described it as a combination of states and processes.)

As he read, Rafa made a note: *To cognize is to know*.

After some reflection, Rafa felt that he understood what *cognition* means, though he was not very confident.

On the Internet, Rafa found that some websites described Higher-Order Cognition (HOC), as the ability to engage with challenging problems. But they didn't explain what counts as a challenging problem. Some websites described HOC as the process of thinking (i) creatively (integrating facts and ideas that were unconnected before), and (ii) critically (testing the evidence and reasoning used in arguments).

Now, Rafa felt that he had only a very hazy understanding of the word. If someone were to ask him what Higher-Order Cognition was, he was not sure if he would be able to give a satisfactory response.

He tried to gather his thoughts about what he had read, made notes, and took them to his mother. Samira read through the notes and smiled at him.

Samira: So, tell me, what did you find out?

Rafa: I have a vague idea, but I'm not sure. If my classmates Anu or Neel were to ask me, I'd be in trouble. Can I try telling you?

Samira: Oh...those twins, your best friends? Well, tell me. I've been waiting!

Rafa: Higher-order cognition seems to be related to intelligence. But they are different. Intelligence seems to be the capacity to do things with our minds.

Samira: And is that a capacity that people are born with? Or is it something that you can develop through effort?

Rafa: Hm! I think we can develop it, just like our physical capacity. I mean, through proper nutrition and physical training, we get better at what we do with our bodies. So we should be able to do something similar to what we can do with our minds, right?

Samira: Very reasonable! So what do you think higher-order cognition is?

Rafa: Right now, I think it covers mental processes like creative thinking, critical thinking, problem-solving, reasoning, and inquiring.

Samira: Well done, Rafa. That is good progress for now.

Rafa: Oh, that reminds me, Mom. Anu-and-Neel's mom has invited me for breakfast this Saturday. Can I go?

Samira: Sure. You don't have any other program that day, right? So yes, go!

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Samira resumed work on her laptop, but a moment later, she looked up.

Samira: Rafa, why don't you invite Neel and Anu as well as their mom to join us for dinner one day? I'd like to meet them.

Rafa: When?

Samira: Hmm. Let me see. How about on 21st December 2519?

Rafa: Mom!!! Did you say December 2519!?

Samira: So I did.

Rafa: But we can't invite them for dinner in 2519!

Samira: Why not?

Rafa: Because we'll all be dead by then!

Samira: Are you sure? You *believe* we'll be dead by 2519. But do you *know* that?

Rafa: Mom!!! You can't be serious! What do you mean by "are you sure?" Of course, I am! Human beings don't live for even 150 years, let alone 500 years.

Samira: Rafa, do you realise you are thinking critically about this?

Rafa: Oh...Am I?

Samira: Would you like to get better at it?

Rafa: Of course, yes.

Samira: In that case, you need to learn to doubt and question yourself first. So tell me, step by step. how do you know we'll all be dead by 2519?.

Rafa: Well, that's easy. For one thing, we know that you and I are human beings. And human beings don't live for 500 years. So, we'll be dead by 2519. Is that a good answer?

Samira: It's a good beginning. You just gave me an argument.

Rafa: Argument?

Samira: Mm-hmm.

Samira walked over to the whiteboard in their dining room and began writing:

1. No human being has lived for 500 years. (what we know)
2. You and I are human beings. (what we know)
3. You and I won't live for 500 years. (what we conclude from 1 and 2)

Samira: What I've written here, is that what you meant?

Rafa: Yes. So, that's called an argument?

Samira: M-hmm. The statements in 1 and 2 are called premises.

Rafa: Premises?

Samira: Yes. A premise is something we take to be true. Premises are the starting points for an argument. And statement 3 is your *inference*. You arrived at it from statements 1 and 2. It is the conclusion that follows logically from your two premises.

Rafa: Cool! Got it.

Samira: Rafa, what happens if one or more of our premises turn out to be wrong? Take Premise 1 — how do you know that no human being has lived for 500 years?

Rafa: Two reasons. One, I've seen people die well before the age of 100. Two, I've never met or heard of anyone living even till 150, let alone 500.

Samira: Good justification.

Rafa: Justification?

Samira: Justification is giving reasons to someone to show that your inference or your conclusion is right. The reasons you gave me to defend Premise 1 are your justification for that premise. Similarly, Premises 1 and 2 are the justification for the conclusion in 3.

Rafa: Oh, okay.

Samira: What I'm asking you to consider is this. Is it possible for Premise 1 to be wrong?

Rafa: How can it be wrong?

Samira: Imagine that there are a few immortals among humans. They've lived beyond 500 years. Without being detected by anyone. Isn't that possible, though extremely unlikely? One of the teachers at your school, for instance, may be an immortal for all you know. What if she is someone who moves to a different town and different school before anyone can notice that she doesn't grow old like other people?

Rafa: Hmm, extremely unlikely, but possible, I guess. But what's your point?

Samira: Just that we believe many things that are just conclusions from premises that we haven't actually stated. Only when we state them explicitly can we question them, to discover if they're true or false.

Rafa: You're saying Premise 2 could also be wrong?

Samira: Yes.

Rafa: Mom!! Are we not humans?

Samira: I'm just saying we could be mistaken in our belief that you and I are humans.

Rafa: But how can that belief be wrong?

Samira: What if we're both aliens, and that I was brought to Earth as soon as I was born? And your Dad too?

Rafa: You're talking Sci-fi, Mom! (after a brief pause) Extremely unlikely, but I guess it's not impossible.

Samira: So, we can't be completely certain that you and I are human beings, right?

Rafa: I guess so.

Samira: That's all I'm saying. Even when we're very confident, we can never be absolutely certain.

Rafa thought for a few moments. Being certain about something means *knowing* that it is the only way things could be. His mother had put him in a tough spot, but he was enjoying the conversation.

Rafa: Can I summarize the points you've made?

Samira: Go ahead.

Rafa wrote on the board:

1. Many of our beliefs are conclusions.
2. These conclusions are based on premises that we take for granted.
3. It is important to make these premises explicit, and to question them.
4. If we question them, we may discover that some of them are wrong.

THINK & DO #1

Do you have any beliefs you are certain about? Think carefully about them.

Choose ONE of them, and write down the justification for that belief. Do it the way Samira did, by stating your premises explicitly so that you can figure out if they are true, or false.

Rafa enjoyed learning with his Mom, but he remembered their starting point.

Rafa: So, Mom, about inviting Neel and Anu for dinner. We have two possible conclusions. One, that you and I *will* be alive on 21 December 2519. And two, that you and I *won't* be alive on 21 December 2519. You agree that two is more reasonable than one, yes?

Samira: Yes, I agree.

Rafa: Good. So, when should we have Neel and Anu and their Mom over for dinner?

Samira: How about next Sunday?

Rafa: Sounds good.

3 White Crow on the Balcony

Anu and Neel were having their regular vacation breakfast of *idli* and *saambaar*. Their parents had left for work, and they were by themselves. When Anu heard a crow on the balcony outside, she suddenly remembered something.

Anu: You know that white crow that comes to the balcony every morning, Neel? Yesterday it turned up with a friend — a regular black crow, not a white one.

Neel: What white crow? And it came to the balcony? White crows don't even exist!

Anu: What do you mean, they don't exist? I've been seeing one every morning for weeks, and I've told you about it. Many times. But you never pay attention. At least one white crow does exist. And even if only one white crow exists, then it can't be true that no white crow exists.

Neel: You are being irrational, Anu. Or maybe you are hallucinating. Because everyone knows that all crows are black.

Anu: No, Neel, you are the one who is being irrational, and completely closed-minded.

Neel got up, muttering, "I really don't want to talk about this," and walked off.

THINK & DO #2

Write down the meanings of *rational* and *irrational*.

Who was being IRRATIONAL in the conversation above?

(a) Anu (b) Neel (c) Both (d) Neither.

Justify your answer in writing so that you can refer to your notes later.

During lunch, Neel returned to their breakfast conversation.

Neel: Anu, suppose we assume that white crows don't exist.

Anu: But they do exist, Neel!

Neel: Ok...ok. Relax. I just want you to consider for now that white crows don't exist.

Anu: Okay. Now what?

Neel: So we assume that white crows don't exist. And let's also assume that you were not hallucinating. Then, the white bird you've been seeing, could it be a crow?

Anu: No. If white crows don't exist, then the conclusion that follows logically is that the bird I've been seeing is **NOT** a crow, because it is white.

Neel: Thank you, Anu. I rest my case.

Anu: You cannot get off so easily, Neel. Let me ask you a counter-question. Let's assume that the white bird I've been seeing every morning **IS** a crow. If so, do white crows exist?

Neel: I guess so.

Anu: So, here's what we have so far. If white crows **DON'T** exist, it follows that the bird I've been seeing is **NOT** a crow. And if the white bird I've been seeing **IS** a crow, it follows that white crows **DO** exist.

Neel: Right. We now have two statements:

1. White crows don't exist.
2. The white bird that you have been seeing every morning is a crow.

They can both be false. But, they can't both be true at the same time, because they contradict each other. So when we put them together, we get a logical contradiction, right? And we can't allow that. This means that we have to reject one or both statements.

Anu: Exactly. You reject statement 2, and I reject statement 1. So we arrive at different conclusions. We are both rational, Neel, but only one of us supports the true statement.

Neel: And who's that?

Anu: Me, of course! (laughs)

THINK & DO #3

What reasons can you think of to justify each of these positions?

1. White crows don't exist.
2. The white bird Anu has been seeing every morning is a crow.

The next morning, Anu saw the white bird again and hurried to wake Neel up. Neel dragged himself sleepily to the balcony and stared at the bird Anu was pointing at.

Neel: I do see a white bird that looks just like a crow. But, something tells me it's not a crow.

Anu: You need to do better than that, Neel. Give me some reason for that judgment.

Neel: You mean that I have to give you a rational justification for my judgment?

Anu: Exactly. How do you know that the white bird we both saw is NOT a crow?

Neel: To answer that, we need to define what a 'crow' is.

Anu: M-hm, yes. We need to figure out what makes a bird a crow, and what makes it not a crow. Ever thought we would be asking this question! (laughs)

Neel: (laughs) No, never! This is going to take some work. Let's do an Internet search to see if we can find a definition.



THINK & DO #4

Do an Internet search for 'crow'. See if you can come up with criteria to tell the difference between birds that are crows and birds that are not crows.

Neel and Anu continued their conversation at home that evening.

Neel: Listen, Anu. I don't know if white ravens exist. If they do, and if the white bird we saw was a raven, we can conclude that it was not a crow.

Anu: But Neel, ravens are a *sub-category* of crows, just like parakeets are a *sub-category* of parrots. So, if that white bird is a raven, then it follows that it's a crow.

Neel: Aah, I get it. But how do you know ravens are a sub-category of crows? Suppose ravens and crows belong to different categories. So a bird can be a raven or a crow, but not both. Just like insects and birds.

Anu: You mean, they are mutually exclusive categories.

Neel: Exactly.

Anu: Fine! If ravens and crows are mutually exclusive categories, then we conclude that:

1. If a bird is a raven, then it's not a crow; and
2. If a bird is a crow, it's not a raven.

BUT, if ravens are a subcategory of crows, then we conclude that:

3. If a bird is a raven, then it's a crow.

Neel: Agreed. So, which one? Subcategory, or mutually exclusive categories?

THINK & DO #5

Try to answer Neel's question: Is raven a type of crow, or are ravens a different category from the category 'crow'?

Here is what Anu and Neel found on the Internet:

1. The entry on "Ravens and Crows" on a website called BirdNote highlighted the differences between ravens and crows:

"Ravens often travel in pairs, while crows are seen in larger groups. Also, study the tail as the bird flies overhead. A crow's tail is shaped like a fan, while the raven's tail appears wedge-shaped. Another clue is to listen closely to the birds' calls. Crows give a cawing sound, but ravens produce a lower croaking sound." [https://www.birdnote.org/search/node?keys=ravens and crows](https://www.birdnote.org/search/node?keys=ravens+and+crows)
2. The Wikipedia entry on "Corvidae" listed crows and ravens as part of the same family:

"Corvidae is a cosmopolitan family of oscine passerine birds that contains the crows, ravens, rooks, jackdaws, jays, magpies, treepies, choughs, and nuthatchers. In common English, they are known as the crow family, or, more technically, corvids." <https://en.wikipedia.org/wiki/Corvidae>
3. The Wikipedia entry on "Crow" said that *corvidae* and *crow* are synonyms.
4. The Wikipedia entry on "Raven" said: <https://en.wikipedia.org/wiki/Raven>

"There is no consistent distinction between "crows" and "ravens", and these appellations have been assigned to different species chiefly on the basis of their size." It also says that crows are generally smaller than ravens.

THINK & DO #6

Consider these two statements:

1. A raven is a type of crow.
2. A raven is not a type of crow.

Given that we reject logical contradictions, these two statements can't both be true at the same time. So, which one would you accept? Why?

The next morning, the conversation about crows and ravens resumed after breakfast.

Anu: Hey Neel, Sanju didi likes watching birds, and taking pictures of them. Why don't we ask her what she knows about crows and ravens?

Neel: Great idea! Let's go!

When Anu and Neel got to Sanju's home, she welcomed them into her dining room.

Sanju: So what brings you two here this morning?

Anu: We've come to ask you something, Sanju didi.

Sanju: Ask away.

Neel: What's the difference between crows and ravens?

Sanju: May I know what makes you ask this question?

Anu: We're trying to figure out if a bird that visits our balcony every morning is a crow, a raven, or some other kind of bird. To do that, we need to know the defining traits of crows and ravens.

Neel: Our Internet search gave us conflicting answers. Some websites say ravens are a subcategory of crows. Others say that crows and ravens are mutually exclusive categories.

Sanju: You're asking two questions. One is about defining categories. In this case, it's the category of crows. The other is about subcategories: if two groups are sub-categories of the same category.

Anu: Will you help us, Sanju didi?

Sanju: Of course, I will, as much as I can! But right now, I have to leave for a meeting, so I'll let you have my observational notes on crows and ravens. You might find some interesting stories there. And, thank you in advance for returning my notebook when you're done with it.
[Brings them her notebook.]

Anu: Thank you, Sanju didi! We'll take good care of your notebook and return it after we are done.

Neel: Thank you, Sanju didi! Have a good meeting.

[DIALOGUE TO BE CONTINUED... PERHAPS]

4 What Do These Examples Show?

You may have found our examples somewhat unusual. Did you notice what they have in common?

For example, take the questions that came up.

- Did we *give* you answers? No, we just *pointed to* ways of looking for answers.
- It was not possible to answer the questions by recalling what you have memorized, by making calculations, by asking someone (for an answer), or by searching on the Internet.
- We don't know if a question had only one 'correct' answer.

The search for answers to these questions can be a quest, an adventure. It takes time and patience. You may be often pushed to question what you have taken for granted. So don't rush, don't panic. Take your time to answer. And do revisit your answers or discuss them with friends.

The dialogues between Rafa and Samira explore the issue of *how we know what we know*. There are so many things that we take for granted that we know. We don't stop to ask: "How do I know this?" or "Why do I believe this?" In this book, you will learn how to answer these questions.

These dialogues introduce some of the tools for exploring and inquiring. They also highlight some of the fundamental concepts of inquiry and critical thinking, like *premises, reasoning, conclusion, and justification*.

The dialogues between Anu and Neel may seem to be about whether white crows exist. In fact, they are more about the value of *doubting and questioning what we believe to be true*. They show that to give reasons to defend a position, one must articulate that position as precisely as possible.

The examples in this unit would have given you a taste of the process of inquiry, the quest for *rationally justified conclusions*. You will have more opportunities for practice and exploration in the remaining units of this book.

We hope that you will enjoy the process of asking questions and searching systematically for rationally justified answers to the questions you pose, working independently and also with others. Like life, learning is far more fun if done with friends.

Happy journey!

We learn more by looking for the answer to a question and not finding it than we do from learning the answer itself.

Lloyd Alexander