

Note from the Authors

Critical ❶ / Complete ① Guide

“A guide is a person who leads anyone through unknown or unmapped country. This includes a guide of the real world (such as someone who conducts travellers and tourists through a place of interest), as well as a person who leads someone to more abstract places (such as to knowledge or wisdom).”

— Wikipedia

A **textbook** on the other hand is a manual of instruction in any branch of study. Textbooks are produced according to the demands of educational institutions (Source: *Wikipedia*).

I have come across many students whose feedbacks were unbelievably similar:

“Since it is compulsory for me to get the textbook, I feel that there is no further need to get the guide. Since the guide is no more than regurgitating what is already mentioned in the textbook, I would rather try to learn by studying the textbook first and then follow by practising some of the readily available exercises provided by the teacher. I believe teacher knows best. When the going gets tough, it is usually due to my large class size. I will then seek private tuition instead.”

Unfortunately, no matter how good the private tutor is, the private tutor is only willing to spend at most 1–2 hours per week to coach the student. This approach clearly is inadequate. If it is, then every single student would have achieved distinction grades with ease. But, that is not the current scenario. **Accurate self-education is therefore of paramount importance.**

Having a competent guide is very important in developing a student’s competence in the subject matter. The *guide* professionally collates every single important curriculum in the subject matter and presents it in a logical manner. The aim is to provide expert guidance to the student by helping him to acquire his competence as fast as possible; much like the *local trekking guide* that will take the unfamiliar climber personally (no matter how competent is his climbing skill) through the safest and smoothest passage to the mountain top.

To illustrate this important relationship, let’s go through the various aspects of a **competent guide**:

❶ Question-answering techniques:

No *textbook* is allowed to teach *question-answering techniques* as it is forbidden by the education institution. The education institution is expected to maintain a holistic approach to the curriculum. **Spoon-feeding is clearly not one of them.**

Example

What is the difference between speed and velocity?

Most students (and some junior teachers) would have smiled at the simplicity of the question asked and naively suggested the answer to be:

Speed is a scalar quantity, with only a magnitude defined; while velocity is a vector quantity, with a magnitude and a direction defined.

The students expect no less than a full credit. But, they are all mistaken.

The examiner expects the student to be able to explain the difference particular to this case. Otherwise, the question could easily have been between the quantities of say, speed and magnetic field, or between air and building material (basically any two different things). Clearly the examiner meant that speed and velocity is somehow related and hence, the examiner intends to assess the student’s ability to discern its particular difference. The expected answer is therefore:

Velocity is a vector quantity, with a magnitude and a direction defined; while speed is only the magnitude of the velocity, hence, a scalar quantity.

Subtle, but different. This answer would have gained full credit.



② **Definitions and statements of fact:**

Example

Define speed?

Some students would have suggested the answer to be:

Speed is defined as the change in the distance travelled per unit time.

Some schools would have given full credit to this answer. But, other top schools would have marked this answer as ‘incorrect’. These top schools expect the students to give the answer as:

Speed is defined as the change in the distance travelled with respect to time.

The top schools reasoned that the former answer is a physical formula and not a statement of physical fact, which implies that the statement could not be applied in other planets or different system of base quantities.

A competent guide would have collated all these relevant examiner’s reports to ensure the correct presentation of **accurate education**, so that the student can confidently score. A *textbook* doesn’t perform this role.

③ **Working knowledge:**

Example

Find the inverse of the function of $f: x \mapsto \frac{1}{x-1}$, $x \in \mathbb{R}$, $x \neq 1$.

Again, a fair number of local textbooks suggested the following working to the final answer, which many students not being wiser followed:

$$\text{Let } y = f(x) = \frac{1}{x-1},$$

Rearranging and making x as the subject,

$$x-1 = \frac{1}{y} \Rightarrow x = \frac{1}{y} + 1$$

\therefore The inverse function is:

$$f: x \mapsto \frac{1}{x} + 1, x \in \mathbb{R}, x \neq 0.$$

The inverse function cannot “miraculously” appear after the statement, $x = \frac{1}{y} + 1$. It is

just not possible. **Mathematical deduction must be made on firm mathematical ground.** By being able to deduce the final answer is not the end itself, the approach must be sound and persuasive. Therefore, before granting full credit, the examiner must be convinced that the student knows the exact reasoning behind the derived answer.

The competent guide would have suggested this simple and yet exact approach:

Let $y = f^{-1}(x)$, the required inverse function. — ①

Perform a function operation on y:

$$f(y) = f[f^{-1}(x)]$$

A property of function: Any function of variable, x, being operated upon by its own inverse function will yield back the variable, x:

$$\Rightarrow f(y) = x$$

$$\Rightarrow \frac{1}{y-1} = x \Rightarrow \frac{1}{x} = y-1 \Rightarrow \frac{1}{x} + 1 = y = f^{-1}(x)$$

∴ From ❶, the inverse function is:

$$f : x \mapsto \frac{1}{x} + 1, \quad x \in \mathbb{R}, \quad x \neq 0.$$

❷ **Wrong facts:**

Example

Posted on stomp.com.sg on 10 Nov 2009

MOE approved Physics textbook teaches my nephew the wrong thing.

A STOMPer's nephew came home crying after his GCE 'O' level Physics exam. He answered a question according to what he studied from the MOE approved textbook, only to find out later that it was wrong.



How can the MOE approved textbooks, which so many students use, carry such errors and ambiguities, questions this STOMPer.

Says this STOMPer:

"My nephew who sat for his GCE 'O' level exam came back crying and showed me his Physics Paper 1 (5058/01) in which Q19 says:

- What is the refractive index of a medium?
- A the ratio of the speed of light in air to the speed of light in the medium.
 - B the ratio of the speed of light in the medium to the speed of light in air.
 - C the ratio of the speed of light in the medium to the speed of light in vacuum.
 - D the ratio of the speed of light in vacuum to the speed of light in the medium.

"According to the internet, which I have checked the answer is 'D'.

My nephew who wrote the answer as 'A' later consulted his teacher after the exam and was told that the answer is 'D'.

According to his textbook page 231 the authors say 'It has been proven that the refractive index is a ratio between the speed of light in air or vacuum and the speed of light in a medium'.

The cover of the school textbook titled GCE 'O' Level Physics matters by Charles Chew and Chow Siew Foong and there was a seal with the words 'Approved by Ministry of Education for use from 2007 - 2011'

This was the textbook used in many of our secondary schools and endorsed by the MOE.

If the textbook has errors or ambiguities why does MOE recommend that schools use this particular textbook?"

A competent guide would have explained that the determination of any physical standard, such as the refractive index, must be found based on invariant bench–mark(s). Air being denser or less dense in different parts of earth would not have been a good candidate. At best, it can only be used as a good proxy or approximation.

"Knowledge is power. Total knowledge, acquired through accurate education, is absolute power."

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