

Aptitude Tests, Talent Tests, and Achievement Tests

Tara Mohanan



Any educational program must begin with a clear articulation of its desired learning outcomes. This articulation must percolate in spirit throughout the design of the program's admission procedures, syllabus, textbooks, assessment, pedagogy, and infrastructure

IMAGINE THAT the Government of India is setting up an Indian Academy of Dance that offers a prestigious four-year Bachelor's program.

During the first two years, students train in all forms of Indian dance and a range of non-Indian dance forms. In the third and fourth years they specialize in a specific dance form of their choice, such as Bharathanatyam, Odissi, Ballet, Contemporary, Flamenco, and so on. The program admits students with no prior training in dance. There are more than fifty thousand applicants for only two hundred seats. Clearly, the program needs a reliable way to identify the most promising two hundred out of the fifty thousand. It needs an *entrance test* that probes into the applicants' *aptitude* for dance—their *potential* to become high-caliber dance artistes, as distinct from their *achievement*—one that probes into their ability to perform, design, and critically evaluate a dance piece.

Three Challenges for Higher Education

Imagine also that the Academy offers a Master's Program. It admits only applicants with prior training, whether from the Academy or elsewhere. There are five thousand applicants for twenty seats. For this program, the Academy needs an entrance test that probes into

the applicants' *talent* for dance—one that assesses both the potential to become high-caliber dancer artistes and the *dedication and seriousness* with which they will transform that potential into actuality. Such a talent test must factor out the effects of *prior training*, such that applicants with high-caliber training (because of good fortune and/or economic resources) and those without that benefit are on level playing field.

Also, a final exam at the end of the Master's Program must evaluate the students' *achievement* as dancers, distinguishing excellent dancers from very good ones, and good dancers from ones who do not qualify.

In the above scenario, if we replace 'dance' with medicine, engineering, technology, science, management, or architecture, we get a picture of what we must pay heed to when admitting students to a prestigious higher education program, or certifying its graduates as good, very good, excellent, or outstanding.

Defining the Desired Outcomes of Learning

Whether at the entrance stage or at the exit stage, a good test should be grounded in a clear characterization of what the students in the program are expected to learn. An entrance test that probes into students' potential to learn

The author is an internationally well-respected theoretical linguist, with a Ph.D. in Linguistics from Stanford University, and has made significant contributions to linguistic theory as a researcher. She taught at the National University of Singapore from 1990 to 2006.

the art and craft of medical diagnosis, and an exit test that probes into their achievement in medical diagnosis, are appropriate for a medical school, but not a test that probes into the potential for or achievement in choreography, or a commercially viable technological invention. Testing an understanding of the Big Bang theory makes sense for a science program, but not for an engineering or medical program.

Education is a matter of mind and behavior (educated mind, educated behavior), not a matter of degrees, certificates, and diplomas (educational qualifications). Someone with not even a school-leaving certificate can still be highly educated; someone with a PhD might still be uneducated.

In contrast to such specific abilities, there are broader qualities that are relevant for all programs of higher education, abilities that non-specialist school education ought to promote — such as the ability to observe, to reason, to arrive at rational judgments based on available information, to come up with new ideas, to notice non-obvious connections and generalizations, and so on. This implies two kinds of qualities that educational design must acknowledge:

- *broad qualities* including general knowledge, intellectual abilities, attitudes, predispositions, and mindsets that we expect of all educated individuals; and
- *special qualities* that are of value in a particular pursuit (such as medicine vs. music) that may not be relevant for other pursuits.

The ability to detect logical contradictions and the ability to reason from effects to causes fall into the first category. The ability to engage in legal reasoning and the ability to reason from symptoms to illnesses are specific to law and medicine respectively, as part

of the second category. Both dancers and surgeons need coordination of the hand, eye, and mind, but the skills of performing a graceful dance movement are distinct from those of performing a heart incision.

The rationale articulated above suggests that entrance tests for selecting a small number of candidates from a large pool of applicants contain two parts. One would probe into the broad qualities that come under *general education*: regardless of specialization, we want our doctors, engineers, lawyers, architects, teachers, ministers, nurses, scientists, and CEOs to be educated people. The other would probe into the *special qualities* that distinguish one career path from another. A person with a high potential for research in theoretical physics may not necessarily have comparable potential for cardiac surgery.

Given the two-part entrance test idea, the next step would be to articulate clear and precise answers to the following questions:

- What broad qualities do we expect of educated persons?
- What special qualities do we expect of graduates of a given prestigious program that distinguish them from graduates of prestigious programs in other subjects?

Next would be designing assessment tasks that probe into each of these qualities, or at least those that are amenable to assessment through examinations and interviews.

An Educated Person

Education is a matter of mind and behavior (educated mind, educated behavior), not a matter of degrees, certificates, and diplomas (educational qualifications). Someone with not even a school-leaving certificate can still be highly educated; someone with a PhD might still be uneducated. What distinguishes a highly educated person from an uneducated one?

Clearly, one factor is knowledge. We expect educated individuals to be aware of and understand a range of concepts and propositions, regardless of their professions and specializations.

Someone with a PhD in physics, who hasn't heard about the European Renaissance, or the human genome, is uneducated. So is someone with a PhD in Literature, who hasn't heard about quarks, and doesn't know that Pluto is no longer regarded as a planet of the Sun. Taking a step further, if someone believes that the earth revolves around the sun, or that the species existing on the earth today descended from a single ancestor species, but is not aware of the evidence and arguments for (or against) these conclusions, their education is flawed, whether they are scientists, doctors, nurses, engineers, ministers, managers, dancers, poets, or journalists.

Given the centrality of general knowledge in education, we need to work towards a consensus on what goes into this knowledge. By 'general knowledge' I don't mean the fragments of *information* that are tested in TV quiz programs (e.g.: What is the name of Isaac Newton's father? Who was the third president of USA?), but a connected, integrated form of *understanding* needed for functioning intelligently and effectively in the world that one lives in. For this, it

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is more important, for instance, to have an understanding of good and responsible parenting, and of the results of a blood test such that the need for a second opinion is recognized, than to know the square root of a number, or the molecular formula of methane. A consensus on what must go into such general knowledge may not be easy, but if educatedness is an important consideration in education, we need to work jointly to get as close to that goal as possible.

A good way to decide what should go into the *general knowledge* of an educated person is to look for answers to the following questions:

- What should a person be familiar with in order to read, understand, and evaluate the material in articles and books for educated non-specialists (e.g., newspaper editorials, New York Times blogs, Scientific American, ...)? This involves *academic literacy*, as distinct from the basic literacy needed to write a letter, or an application for a job.
- What information and knowledge do we need to cope with situations we face in our everyday lives? (e.g., health issues; advice to teenagers on the choice of educational paths; financial choices decisions

...we need to identify those special qualities that distinguish a high-caliber doctor from a high-caliber theoretical scientist or architect, or a high-caliber IAS officer from a high-caliber lawyer or engineer, and select candidates who have the highest potential to acquire those qualities by going through the program in question

in voting ...) This involves *pragmatic wisdom*.

Going beyond knowledge, we also expect an educated individual to have a range of *thinking and reasoning abilities*, another hallmark of educatedness. These include (but are by no means limited to) the abilities to:

- *learn independently*: learn what one wants to or needs to without having to depend on teachers and educational institutions;
- *think critically*: evaluate matters of the truth of propositions, the effectiveness and efficiency of products and actions in achieving the desired goals, the value system that the goals are derived from, and the moral legitimacy of actions and practices;

- *inquire*: identify worthwhile questions, look for answers to the questions, and arrive at conclusions from those answers;
- *make connections and integrate* ideas;
- *communicate* ideas clearly, precisely, and effectively;
- *collaborate, and work in teams*; and
- *act effectively, morally, and wisely*.

The general-knowledge and thinking/reasoning abilities sketched above would serve as guidelines for constructing the *general education* component of an ideal syllabus for Grades I-XII. If such a syllabus existed, and if the school-final examinations tested the achievement of these goals, then prestigious undergraduate programs could base their selection on the results of those examinations. In the absence of such a school syllabus, we have to design special entrance tests that probe into the relevant qualities of educatedness.

That the first twelve years of schooling should focus on general education does not mean that there should be no room for specialized elective courses. If a student wants to take a course in calculus, particle physics, neuroscience, human illnesses, anthropology, or history of music, these options should be available to them. However, it would be a mistake to design entrance tests to probe into what students learn through such electives, because many deserving candidates may not have the luxury of such courses.

Potential for Specialized Pursuits

The rationale for a two-part assessment — one to ensure a high degree of educatedness, and the other to ensure the highest potential for a given profession — is this. Granted we want our doctors, engineers, lawyers, scientists, teachers, and ministers to be educated in the sense outlined above. We must still ensure that we select those with the most potential to become high-caliber practitioners in each field of specialization. For this, we need to identify those special qualities that distinguish a high-caliber doctor from a high-caliber theoretical

scientist or architect, or a high-caliber IAS officer from a high-caliber lawyer or engineer, and select candidates who have the highest potential to acquire those qualities by going through the program in question.

A short article like this cannot go into all the special qualities we expect from high-caliber professionals in different fields. What given below, instead, is some broad parameters to select from, to distinguish high quality in one field from high quality in another. They would include the capacity to:

- investigate questions of truth (as in basic science, pure mathematics, analytic philosophy...);
- pursue effective and efficient action to accomplish desired goals (as in technology, engineering, medicine, law, management, social work...);
- arrive at inferences based on quantitative information;
- create/invent novel/innovative solutions to problems;
- take quick and effective decisions;
- solve problems quickly and effectively;
- reason with formal symbols and expressions;

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- work collaboratively and harmoniously in teams;
- articulate one's ideas clearly, precisely;
- take criticism in a constructive spirit;
- manage people, lead them, and persuade them; and so on.

Other qualities would include:

- intellectual curiosity in matters not directly relevant to one's profession;
- habit of reading non-fiction meant for educated non-specialists;
- commitment to and the pursuit of the well-being of others;
- confidence; mental stamina; emotional equilibrium; and so on.

Not all of these qualities lend themselves to testing, especially in a time-bound written examination. Nor is this list exhaustive. My intention here is to simply point to the need to explicitly articulate such qualities, depending on what is we are looking for when selecting candidates for a particular career-oriented program of higher education.

To design an achievement test (whether written or oral), we need a clearly articulated syllabus that specifies the knowledge (information, understanding), abilities, attitudes, and habits of mind that the program aims for the students to acquire through its educational intervention.

Achievement Tests

The qualities outlined in the preceding sections as relevant for the design of entrance tests are what we might call *general potential*, for programs that open up a range of career paths, and *specialized potential*, for programs that lead to specific career paths. I now turn to achievement tests that assess the students' actualized potential at the end of a high-caliber program.

To design an achievement test (whether written or oral), we need a clearly articulated syllabus that specifies the knowledge (information, understanding), abilities, attitudes, and habits of mind that the program aims for the students to acquire through its educational intervention. To illustrate, compare the following questions:

Question 1

What is the formula for the volume of a sphere?

- A. $\frac{3}{4} p r^2$ B. $\frac{3}{4} p r^3$
C. $\frac{4}{3} p r^2$ D. $\frac{4}{3} p r^3$

Question 2

What is the volume of a sphere whose diameter is 20cms?

- A. 3203.5 B. 4190.4
C. 4188.0 D. 2300.8

Question 3

You are given 100 oranges, and asked to estimate the amount of juice they will yield, without cutting or squeezing any of them. Which of the following strategies would you use? You may tick any number of options, but marks will be deducted for inappropriate choices.

- A. Put an orange between two blocks
B. Make an assumption
C. Use a ruler to measure length
D. Use a bucket filled with water
E. Use a measuring cup
F. Use sampling
G. Use statistics
H. Use mathematical modeling
I. None of the above

Questions 1, 2, and 3 differ in terms of what they test, and how long they take to answer. Question 1 tests *familiarity* with partially memorized information: students don't have to know how to calculate the volume of a sphere. Question 2, besides familiarity with the formula, calls for an ability to *apply* the formula to calculate volume based on given information. Question 3 goes beyond information and mechanical application to probe into a *complex form of thinking and creative application based on understanding*: using A, C, we measure the diameter of an orange; using F, G, we calculate the mean diameter of the given oranges; modeling an orange as a sphere (H), we calculate the volume of the sphere from its diameter; and making an assumption (B) about how much of an orange is peel and pulp, we estimate the amount of juice in an orange.

Questions 1 and 2 can be answered in less than two minutes. A three-hour test looking for information recall or high-speed application without thinking can ask a hundred such questions (roughly two minutes per question). Questions

that probe thinking abilities, however, must allow sufficient time for thinking through the given information and arriving at an answer. If the syllabus of the program specifies learning outcomes like critical thinking, critical reading, understanding of evidence and arguments, and inquiry abilities, a two-hour test cannot have more than, say, six questions.

My point about the time allocated for each MCQ applies to entrance tests as well. Tests that don't allow time for thinking cannot test understanding, reflection, critical thinking, creativity, and imagination.

Concluding Remarks

We began with a hypothetical academy of dance. The point of that discussion was that any educational program must begin with a clear articulation of its desired learning outcomes. This articulation must percolate in spirit throughout the design of the program's admission procedures, syllabus, textbooks, assessment, pedagogy, and infrastructure. The quality of a program depends on the quality of all of the above, though of these, assessment is of particular importance.

In raising the quality of education, focusing on assessment — probing into

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aptitude and potential at the entrance stage, and achievement at the exit stage — has a significant advantage: it automatically calls for reforming syllabi and textbooks, to be aligned to the qualities that are tested. Given such a reform, teachers would be motivated to adjust their pedagogies accordingly. Teacher training itself would then be guided by the nature of assessment. It would make sense, therefore, for the government to invest its efforts not only in the formats of assessment but also in what is being tested by the assessment tasks. □

(E-mail: tara.mohanan@gmail.com)