Guarding the wrong gate

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Recent news has included tragic stories of suicides in coaching centers in Kota (30 in 2015, most recently a fourteen year old child from Bihar). The competition for getting into good colleges in India is harsh. Getting in seems to be the main challenge, however. Once admitted, many students float along lazily toward low-risk graduation. In academic terms, this is backwards.

The guard at the IIT gates is their selection process: once called the IITJEE, now a two-step called the JEE Main and Advanced exams, called simply the JEE below. The success rate is below two percent, with under 28000 qualifying from 14 lakhs appearing for the JEE Main. Many aspirants spend years on grim preparation, avoiding extracurricular activity, closely managed by professional coaching institutes, with everything riding on one exam. The JEE is relative, not absolute: even if everybody works harder and improves dramatically, the number selected will remain the same. Each candidate tries to work harder than lakhs of others, with 98 percent of them guaranteed to fail.

For those who enter the IITs, career prospects are typically excellent. Their mental acuity is thenceforth taken for granted. Some go on to excel academically. Many others lose steam or lose motivation through interaction with seniors and peers. They perform below potential in engineering courses and graduate with poor grades. But they are employed anyway by companies that value their JEE success over their lackluster college record. Every placement season, the press reports amazing salaries offered to a few students, usually by some foreign company. The general mood is, "How bright these people are, how well rewarded by a world that recognizes their value!"

The JEE has maintained academic independence, avoided influence from business or politics, and has a clean reputation. These are good things. Yet, does the JEE truly measure great talent? Let us examine the facts.

With scientific instruments, we know what they measure and the accuracy with which they measure it. For the JEE, we know neither. It is unclear what the JEE measures beyond the ability to answer many three-minute multiple choice questions or MCQs (admittedly in technical subjects). MCQ talent is largely irrelevant to engineering. For example, it is unclear that high JEE rankers make better practical engineers than low rankers do. Or that JEE rank is correlated with genuine creativity, the patience to tackle a complex problem over several years, persistence in the face of systemic difficulties, professional honesty and ethics, social conscience, all qualities one might desire in people being educated in premier institutes using public funds.

Second, with a few hundred MCQs and negative marking to chop scores up, there can only be several hundred distinct total scores. There are obviously very many tied scores, broken by essentially arbitrary rules. The precision of the measurement is low. The individual ranks that the JEE assigns to lakhs of students are scientifically questionable.

Third, just about any challenging technical exam with many questions, along with enough tie-breaking rules, can be used to rank as many candidates as we like. If any such exam ranks

fourteen lakh students, the top-ranking two percent will typically be smart due to the sheer numbers involved, with no credit to the exam. Among all such imaginable technical exams, how good is the JEE? Nobody knows. In other words, if many IITians are indeed smart, that may simply be because of the number of people competing to get in rather than any great superiority of the JEE as a selection method.

To summarize, the JEE has (a) unknown and unproven measurement objectives and errors, (b) poor precision, and (c) no scientific comparison against other selection methods.

The JEE today is a consequence of its own history, followed by compromises forced by huge numbers: widening the syllabus, raising the difficulty, and adopting the MCQ format. These are indeed compromises and not improvements. Raising the difficulty does not raise the students' talent; it merely makes it easier to rank the toppers.

The JEE uses machine-graded MCQs because there is no other practical way to administer a few-hour exam to lakhs of candidates with uniform grading standards. Human grading cannot be uniform across lakhs of answer scripts, and replacement of three-minute MCQs with twenty-minute questions would change the flavor without addressing the irreparable flaw of the JEE.

The irreparable flaw of the JEE is the enormity of the contest itself. No matter what exam one chooses, if 14 lakh people compete brutally for the top two percent of spots, then the stakes are too high. Many who succeed will be damaged by the sheer effort, losing their love of learning before the real learning begins. There will emerge many who game the system, or coach students, or publish "guess papers" etc., making it biased.

There is ample evidence that the JEE is biased. A disproportionate number of successful students come from the CBSE board (55 percent, or 14955 among those qualifying in 2014). Success rates among state boards differ wildly: 8115 from three state boards, 327 from seven others, and just one each from three others (2014 data). Similarly, students from somewhat wealthy families are overrepresented among JEE successes. So also are men over women, and urban over rural candidates. Are rich CBSE-enrolled city boys inherently more talented than others? Not likely.

Coaching institutes distort the picture severely, making fortunes thereby. If the entrance exam is a wall that must be jumped over, coaching institutes stand outside the wall offering ladders for a fee. Over time, JEE paper setters have noted the ladders and raised the wall. The coaching institutes have lengthened their ladders. Those without ladders jump from below.

The rise of coaching institutes has led a committee headed by Ashok Misra to recommend better MCQ exams, online help from the IITs themselves to reduce the power of coaching institutes, removal of board marks from the partial consideration they have recently received, and generally a roadmap to eroding the power of coaching institutes while reforming and strengthening the JEE. But the coaching institutes fill a need. We must attack the need and not the institutes.

Examine the facts. Many IIT students neither show interest in core engineering, nor seek nationally relevant engineering jobs. They mostly value employment in non-core-engineering domains. The difficulty of the JEE has itself risen far beyond what is needed to pass challenging engineering courses; yet the students who clear the JEE often do poorly at these same courses. These cannot be the fault of coaching institutes, nor repaired by online coaching from IITs that weakens those coaching institutes. We must reexamine our axioms.

The JEE's problem is not what it is, but what it does. Its two main distinctions, namely (i) the hard contest for very few successes, and (ii) the perceived reliability of its evaluation, seem to be causing the trouble.

Consider the hard contest. Could it be made much, much harder? Sadly, yes.

Suppose, as a thought experiment, that in addition to tackling math, physics and chemistry MCQs, the candidates were also required to develop other excellent qualities, such as knowledge of literature and languages, lovely penmanship, physical fitness, and a record of social service. To test for these qualities, we might additionally require the candidates to (a) memorize texts of poetry, (b) learn extra languages, (c) produce beautiful handwriting in a timed test, (d) run a mile, and (e) present proof of, e.g., teaching poor children for free. These five added challenges would make the JEE much harder. But would IIT aspirants give up and stop trying? No. They would merely rise to meet these challenges. Some aspects (like handwriting, teaching poor children, and language training) would be managed by "good" schools before Class 8. Coaching center evenings would include physical training, and infinitely-looped poetry might play through headphones while these tired soldiers slept.

The JEE cannot be reformed. One can change the exam pattern, even extend the range of near-impossibilities asked for, and it will not matter. Enthusiasm will remain high, the contest brutal, the coaching classes overpopulated, the success rate two percent. Too many of those burnt-out successes will become uninterested in science, and the "failures" who gave it their best will be even worse off than the successes.

As long as overpopulated India equates the JEE with salary outcomes that cannot be won equally reliably elsewhere, parents will urge their wards through this brutalization that masquerades as academics. And, as IIT professors are depressingly aware, at the time of branch selection many parents will ask not what their ward might learn in a given branch of engineering, but what the typical salary package for that branch is.

This brings us to the second unfortunate distinction of the JEE: the perceived reliability of its evaluation. While it is unclear what the JEE measures, many non-engineering employers do love it. A few ignore college grades and hire by JEE rank alone. Others come to IITs only to administer aptitude tests which, it turns out, are non-engineering MCQs. Yet others give computer programming assignments to students not studying computer science, hiring thereby. Four years of training in the IITs are irrelevant to these employers, and therefore to many students as well.

The JEE has outlived its utility. It does not matter how great our pride in it is, and how unsullied its history of independence. Today, it merely derails the IITs' educational agenda, fosters coaching institutes, burns out students, and dilutes core-engineering aspirations by making it easier for students to connect with non-engineering employers.

We are guarding the wrong gate. The exit gate, and not the entry gate, needs guarding now. The direct JEE-to-employer connection is what makes the IITs' training irrelevant to its own students. This direct connection can be weakened by moving the guard to the exit gate.

If the guard is moved, thereby asking for a higher standard of performance before the degree is granted, then the pressure may shift from the JEE to the degree itself. If the IITs set store by the degrees they grant after four years of evaluation rather than the MCQ scores of a one day exam, the game might change as follows.

Given the demographics (many young people) and socioeconomics (not many high paying jobs) of India, there is probably no perfect remedy to the flaws of the JEE. But one might consider some alternatives, as a thought experiment.

Imagine, for example, reversing the roles of the JEE and board marks. Imagine that students from every recognized Class XII board could be offered admission based on their board-wise percentiles conditional on their ranking within the top ten percent (say) in the JEE Mains. ("Percentiles" means that if a board with one lakh students gets its top one thousand selected, then a board with ten lakh students gets ten thousand selected.)

Critics of using board marks will surely point to non-uniform standards among various boards. But the top one percent of one board may not be inherently more talented than the top one percent of another board. Again, perhaps some boards are less clean than others, biasing the selection; but the JEE is heavily biased anyway, as discussed above. If exit standards are high, then the strong will be separated from the weak. Meanwhile, consider some possible consequences.

Strong JEE aspirants, expecting ranks within 10000, may take it easier. Needing merely to be within about 140000, they may study all the subjects on their board exams and have time left for music or sports. They may manage better to keep their inner lamps burning: retaining a love of learning, studying both science and languages, and contemplating subtle topics outside the reach of MCQs.

Village students from underdeveloped areas, studying in state boards, would have a fairer shot. They would just need to top their local boards, as opposed to a coaching-prone exam whose power centers lie far away.

Many boards have aligned themselves with the CBSE, for no apparent reason beyond the JEE Main exam. This might stop, and smaller boards may revive their identity. Some excellent students may shift to state boards, raising standards in those boards without destroying their diversity.

Girls do relatively well on board exams and poorly on MCQ entrance exams. More girls may get in.

Coaching classes may find their business shifting and, following the money, may move out geographically and spread some benefits thereby. It is hard to coach students for a Meghalaya board exam from Rajasthan.

Once the JEE loses its reputation for extreme exclusivity, JEE-valuing non-engineering employers may rethink their own selection criteria. While this may disappoint those students who view IITs mainly as highways to management consulting jobs, it is not the mission of IITs to help fulfill such nontechnical career aspirations.

IIT students' feelings of being special through clearing the JEE are based on external social factors, and they feel no need to prove themselves any more. If these same students know that IITs offer significant challenges beyond the entrance gate, they might reconsider their premature sense of achievement.

But we must be cautious. Moving the guard, or meaningfully raising the exit wall, will require the IITs to do much introspection.

One cannot merely set tougher exams and give worse grades. We must know our teaching goals, and clarify the students' learning goals. Passing or failing must be tied to whether the latter have been met.

But what should our teaching goals be? Will students start learning with enthusiasm simply upon cracking the whip harder? These questions are tied to other big problems which can only be briefly mentioned here.

We cannot deny that lack of interest among students is partly because of the type of employment available. On the surface, non-core jobs are popular simply because there are not enough core engineering jobs with competitive salaries. But we must look deeper. Is there really no money to be made by solving the common Indian's technological problems? Prahalad famously suggests, in the marketing arena, that millions of poor Indians collectively present a "fortune at the bottom of the pyramid". These same millions of Indians have technological needs for which they might pay as well. Many sectors, including education, health and hygiene, energy, roads and transport, land, water, air, trash handling, material recycling, social equity, safety (human/environmental/food), and so on, are underserved and waiting. But neither our industry nor our engineering education system has concentrated enough on looking at these technological problems as opportunities, developing viable solutions for them, and taking pride in delivering these solutions.

While what industry does is not under the control of IITs, the engineering syllabi of the country are.

The IITs, in both selection criteria and subsequent syllabi, have ignored the humbler technological problems of India. In the JEE there is no role for device building or practical design skills. The IITs' syllabi emphasize facility with abstract thermodynamics, electromagnetics, and so on, as opposed to practical India-relevant applications of these subjects. Some IIT professors believe that such practical applications are somehow easier (though that is arguable); that leading institutions should not work on such mundane details but rather concentrate purely on academic excellence. Yet, if IIT professors, in various advisory roles (e.g., through the AICTE), also generally cause a shift in the syllabi of hundreds of smaller colleges toward these same India-blind abstractions, then much more than the JEE needs rethinking.

(With inputs from Devlina Chatterjee and Sovan Das.)