The Olympic View: Musings on logic evaluation

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Abstract. Since 2004 the Mexican Academy of Logic sponsors a series of annual "Logic Olympics". Central to these contests is the problem of testing and evaluating logical proficiency, so I reflect on why, whom, what, and how to test. I advance the views that testing in logic is fundamental, should have a greater target population, encompass more logical skills, and favor objective testing and application over mere theoretical proficiency.

The humble beginnings

Eleven years ago, at the *First International Congress on Tools for Teaching Logic*, I reported on Mexico's long tradition in the teaching of logic, dating back to the XVI century.[1] I reviewed how in January 1996 a research group was constituted to improve the practice and theory of logic teaching. It was named *Workshop on the Didactics of Logic* ("Taller de Didáctica de la Lógica" or "TDL") and it has spawned until 2010 thirteen international conferences on the teaching of logic, proceedings in book form, online and CD, video-conferences, a series of five anthologies under the common title of *Reason Shared* ("La razón comunicada"), video and audio cassettes, etc. In view of its organization, scope and products, I believe TDL is the most permanent and structured effort to improve the teaching of logic in the world.

At our second *Tools*, I briefly reported the impact of TDL on the Mexican curricula, both for students and for teachers, and about the creation in 2003 of the *Mexican Academy of Logic* ("Academia Mexicana de Lógica" or "AML"). Before moving on to my proposal for interdisciplinary research, I pointed that AML "organizes an annual Logic Olympics since 2004."[2] Today I would like to talk a little more about this activity and about logical evaluation in general.

In 2004, AML sponsored its first Logic Olympics. 642 students participated in the qualifying round and 135 in the finals which took place in Mexico City. It was organized by Maricarmen Cadena Roa, Ricardo Madrid, and Christian Alcocer with the help of 84 teachers from 74 institutions. Although labeled "National" to distinguish it

[1] 2000, "A Group Effort to Discover a Theory of Logic Teaching: The Mexican Experience". In María Manzano (ed.), *Proceedings of the First International Congress on Tools for Teaching Logic*, Salamanca, Spain, pp. 95-97.

[2] 2006, "The research on the teaching of logic: topics, disciplines, and groups". In María Manzano, Belén Pérez Lancho, Ana Gil (eds.), *Proceedings of the Second International Congress on Tools for Teaching Logic*, Salamanca, Spain, pp. 123-132.

from other international competitions, from the beginning it has attracted students from several other countries, some of which have finished among the first places.

A survey of 100 participants in 2004 was conducted and the most common remarks about the tests were that they:

- had a good level
- were well designed or structured
- were fun and creative
- were a good tool for learning
- were too short
- should be better checked for mistakes
- were confusing.

Since 2004, the Logic Olympics have been taking place every year, this year in the State of Durango, Mexico. In spite of logistic and organizational difficulties, this event has all in all been a great success and now is a fixed item among the annual activities of the Mexican Academy of Logic.

It is interesting that the three students that tied for first place in the 2004 competition have gone on to submit papers to both the *International Workshop on Teaching Logic* and the *International Congress on Tools for Teaching Logic*. Seems like the Olympics are a fertile ground to inspire not only students but also future teachers.

Why to test

The explicitly stated purpose of the first Olympics in 2004 was to promote the study of logic among the youth, thru the stimulation, cultivation and perfecting of their interest in this discipline.[3] In 2005[4] I reviewed justifications and desiderata for logic testing, both for teachers and students. In this paper I want to revisit the issue of the evaluations of students of logic and to insist that testing in logic is fundamental.

Competitions are historically an important part of training. In the form of puzzles and challenges they can be both entertaining and educational. An important role of these games is to prepare and train in specially secure environments for future enterprises. Philosophers of old used to play eristic games or ritual competitions like the medieval *obligationes* to better prepare for philosophical life. Playing in a football field is supposed to teach team work and the Greek Olympiads had Greek boxing, wrestling and full-contact, hoplite and chariot racing, and javelin throwing. The training for the Olympics was a training for war but in a secure environment where you would lose if you killed your opponent! Similarly, making a mistake in a logical exam will seldom have the dire consequences that a wrong decision might have in our lives.

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[3] The words in the Call for Participation were: “Su objetivo es promover en los jóvenes el estudio de la lógica, a través de incitar, cultivar y perfeccionar en ellos su interés por esta disciplina”. All the materials of the Logic Olympics referred to in this paper may be inspected at http://www.filosoficas.unam.mx/~Modus/AML/Olimpiada/Olimpiada.htm, unless otherwise noted.

[4] "Espejo de virtudes: Evaluación lógica de alumnos y profesores". *VIII Encuentro Internacional de Didáctica de la Lógica (EIDL VIII)*. Universidad Autónoma del Carmen, Ciudad del Carmen, Campeche.

Testing itself if one of the most important tools in teaching. We should not proceed blindly, ignorant of the status of our students. It would be unfair to overload somebody, even at her or his own request. Yet, oftentimes students are allowed without entrance exams to levels beyond their current capacity. Some people would do away with exams arguing that those failing would be denied the right to further education. But this is a fallacious step. In Mexico we believe in the right to receive a good education, but not in a right to a bad education. And there is no good education without exams for entrance, permanence and successful exit.

Furthermore, without some examination neither teachers nor students can effectively detect the need for support. How can we help our students if we ignore the kinds and degree of their problems? A student without enough preparation for the Logic Olympics deserves additional work and support, not to be cavalierly handed over to the teachers at the next level of studies.

And, at the conclusion of their studies, it would be unfair to certify someone who is not yet prepared. By granting a degree, we give society assurances that people's lives can be put in the hands of architects and engineers, doctors and lawyers. It would be immoral to offer these assurances without proof.

A right to education can not be uncoupled from a demand for testing. Academic scholarship begins by measuring proficiency and is only fulfilled demanding it. If our tests for the Logical Olympics are flawed, the challenge is to improve them. But a logical education that does not begin, is accompanied by, and culminates with testing, turns its back to knowledge of the situation, to accurate diagnostics, and to informed decision.

If the teaching of logical skills has a place in our curricula, it is because it is necessary, not an idle adornment or distraction. It is imperative we confirm the acquisition of something so important to later studies and future life.

As a teacher, I am familiar with the widespread dislike of tests; even some schools in Pedagogy and Philosophy of Education consider tests anathema. No doubt Logic Olympics must look to some people as little more than a reminder of the hardships they had to endure in their own schooling. But a distaste for hardships is a feeble argument against testing. It is also unpleasant to exercise or relinquish junk food. It is only human to wish for perfect health without sacrifices. Unfortunately gain without effort is rare; in the case of logical education, it is impossible.

In Mexico it has become a commonplace to request accountability in all spheres of social responsibility. Some teachers and students accept the logical commitment in the quantifier of the phrase "all spheres": it includes accountability in teaching and learning. It is a logical skill, perhaps the hardest one of them all, to accept our part in the universal instantiations that involve duties, and it is a moral virtue to do so as happily as we would when others agree to be evaluated in their public performance.

Whom to test

The Logic Olympics should have a greater target population. In 2004 the Call for Participation was restricted to Senior High School and College levels. This excluded other possible levels, from grade-school "Philosophy for Children" pupils to graduate

students. It also excluded talented amateurs outside Academia. Part of the rationale was logistics. In spite of allowing for the self-enrollment of any student, the testing in the first phase was coordinated thru teachers at both local and regional levels; only around Mexico City was it possible to enroll independent practitioners of logic. Actually, an independent interest in logic seems to be even more rare than the independent interest to enroll in spelling bees. This reflects the reality that logical instruction in Mexico is still negligible outside Senior High School and College. It is no big comfort for Mexicans to know that some countries do not even have these two levels of logical instruction.

Because of the design of the test, there was another, small, group of students who, although not formally, were for all practical purposes excluded from participating. This group was the students that had no training in formal logic, especially those unfamiliar with the "mathematical logic" tradition developed since the XIX century. In Mexico there are many private, confessional or just plain old-fashioned schools that teach late-medieval logic as a preparation for theology or law. Their instruction does not go beyond syllogistics and a rudimentary theory of fallacies, so these students are not capable of handling logical tasks needed for computer science, modern linguistics, psychology research, contemporary philosophy or even the logical systems useful for law (such as deontic logics) or theology (such as paraconsistent analyses of the "coincidentia oppositorum" in God).

Other groups excluded were those whose logic studies, although relatively modern, did not include standard logical systems. E.g., those that only studied dialectical logics, inductive logics, piagetian operatory logics, typed intensional logics for linguistics, or lambda calculus for artificial intelligence.

In spite of the fact that both at High School and College levels the content of logic courses is similar, it was considered prudent to give prizes at both levels, so that the younger students would not have to compete against their older counterparts. In 2004 the average number of correct answers for High School students was 17.25 out of 30, and none of them in the 26-30 range, while for College students it was 20.81, 5 of them in the 26-30 range. Nobody scored above 27 points. While some of the High School students did obtain better grades than some of their College counterparts, as a group they were clearly outclassed.

For the 2011 Olympics, the organizing committee is adopting the policy, common in this kind of international competitions, of giving "gold", "silver" and "bronze" awards based on individual performance and not on how good or bad the other competitors fare. That is, several students may all win "silver medals" if their performance is in the silver range, irrespective of how many other students of "gold" or "bronze" level happened to be present at the test.

What to test

The 2004 Olympics FAQ, made clear what the exams would encompass. They would be designed to test logical skills, not logical knowledge. Specifically, skills in

propositional and quantificational logic, fallacies and metalogic.[5] The 2004 sample test included 31 multiple-option questions on the following subjects:

1,9,26.- Adding a premise to obtain a natural language conclusion.

2,4.- Identifying logical negation in natural language phrases.

3,13,16.- Equivalence of logical formulas.

5,12,14,15,17,18,19,21,22,24,28,29,30,31.- Adding a valid conclusion to a natural language argument.

6,7,8,10,20,23.- Logical equivalence of natural language sentences.

11,27.- Distinction of truth and validity.

25- Adding a valid conclusion to a formal language argument.

It can be seen easily that this sample test privileged the logical analysis of natural language. Only 3,13, 16 and 25 required handling formal language. This divide corresponds naturally to the distinction between logic as art and logic as science. I will not linger on it or on the minimum logical knowledge, skills and attitudes of a well-educated person, since I have developed my ideas on these subjects somewhere else.[6] Unfortunately, this is not the place either to consider the role of Critical Thinking, Informal Logic, or advanced systems of logic in our Olympiads. But I would like to talk about some expectations about the teaching of logic and some particular logical skills as examples of how the Olympics could easily encompass more logical skills.

Many logic professors believe their class helps develop logical skills. Since logic professors are reputedly rational, we would expect good, hard evidence at the basis of such beliefs. Oftentimes there is little more than wishful thinking and anecdotal evidence to buttress such high hopes about the efficacy of logic courses in the progress of our logical abilities.

As means to acquire and develop clear and rigorous thinking, Plato favored arithmetic, Romans recommended the study of Grammar, the Middle Ages saw a return to Syllogistics, the Renaissance to Rhetoric, and the XIX century praised the study of Latin or Mathematics as ways to develop logical proficiency. Nowadays, we can hear proposals to develop mental skills thru yoga, chess or the practice of computer programming. No doubt all these methods could benefit some people, but it is all too common to encounter great mathematicians, chess players or computer analysts that exhibit poor logical acumen outside their narrow field of expertise.

We face two basic questions: Can we teach logical skills?, and, What are the best ways to go about doing so? No serious handling of these questions can avoid the issue of the measurement of such abilities. Any conjectures about educational effects require psychometric evidence. The quest to improve our methods to evaluate logical skills is a requisite part in the quest to evaluate the teaching itself. So, if we want to improve as teachers it behooves us to employ tested techniques, and to test if a pedagogical technique helps in the acquisition and development of logical abilities we

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[5] "Los exámenes están diseñados para medir habilidades lógicas, no conocimientos sobre lógica. Se examinarán habilidades en lógica proposicional, lógica cuantificacional, falacias y metalógica."

[6] 1999, "¿Qué debe saber de lógica una persona educada?" En Raymundo Morado (Compilador), *La Razón Comunicada: Materiales del Taller de Didáctica de la Lógica*. Xalapa, Veracruz: Universidad Veracruzana, Universidad de Xalapa, Torres Asociados, TDL. 2005, *¿Para quién la lógica?* Cuaderno del Seminario de Pedagogía Universitaria, UNAM. 2008, "¿Por qué y para quién la lógica?". *Cuadernos UCAB*, No. 6, pp. 9-17.

need to measure the degree of possession of these. Only then our pre- and post-tests can serve to carefully measure the impact of out teaching.

The main objective in a logic course is an increase in logical skills; in a sense, in the "intelligence" of our students. To be intelligent has less to do with our attitudes and knowledge than with our abilities. We might have the resolve to resolve a problem and even know how to do it, and yet, without the ability to apply the knowledge our good intentions come to no fruition. Skills are mostly habits, capacities acquired thru repeated application. I can have all the theoretical knowledge about bicycles and the proper attitude; without repeated riding I shall not become a cyclist. I may memorize all the theorems in *Principia Mathematica* and show the best of attitudes and yet be illogical at the time of making important decisions about health, family or career. The development of skills normally requires repeated applications of attitude and knowledge. That is the clearest way in which our logic courses might help our students to become more rational.

The Olympics is not only a great tool to develop the interest of our students, it is also a great testing ground for our own practice as teachers. Teachers can learn from the Olympics a lot about how to better design and test logic courses.

Certainly, not all mental skills qualify as logical skills. For instance, sensorial classification and pre-reflexive mental association require no logical processing. The *New Jersey Test of Reasoning Skills* created by Virginia Shipman mentions twenty two skill areas. Ten are confusing or obsolete, but the other twelve can be defended as logical skills that could be considered for inclusion in our Logic Olympics: Conversion, Logical Paraphrasing ("standardization"), Modus Ponens and Modus Tollens (inclusion and exclusion), Analogy, Identification of Assumptions, Induction (and Probabilities), Ambiguity Detection, Symmetry Recognition, Differences in Degree and Kind, Transitivity, Combinatorics (at least the "4-possibilities matrix"), Part and Whole.

We might want to stretch the notion of logical abilities to include the following: Identification of Inferential Uses of Language, Recognition of Quantification and Truth-Functions in Natural Language, Understanding and Clarification of Logical Nexus, Participation and Organization of Arguments and Debates, Recognition of Contexts of Discussion, Searching for Alternative Scenarios, Analysis, Evaluation and Construction of Arguments.

Ideally, in a logic course students acquire capabilities that may help them to analyze, evaluate and build arguments. Each of these capabilities is a composite of a whole constellation of other skills. The abilities acquired in a logic course run the whole gamut. At one end we have the mnemonic skill to retrieve information. Being able to remember in what century Aristotle created Syllogistics, or Frege his predicate calculus, helps students to develop a perspective of the historical development of logic as a living science. The memory of the ideas of Aristotle and Frege helps to understand the power and the limits of their models of reason, and memorizing methods to detect valid syllogisms and tautologies helps to accurately gauge the validity of a great many arguments. There is a temptation to disregard this ability to recall data, facts and methods. Our bad experiences with excessive emphasis on memorizing can lead us to the extreme of imagining we have no use for memory. Such an overreaction tends to deprive students of the possibility to put previous knowledge in fruitful relation to new data.

Another fundamental ability is analysis. Decomposing ideas, theories or systems into more basic elements helps to disambiguate, and to reduce vagueness and misunderstandings. Basically, it distinguishes things we normally confuse. In a first course in logic it is crucial to be able to distinguish conjunction and simultaneity, exclusive and inclusive disjunctions, material and strict implications, etc. There is a corresponding temptation to ignore this ability by saying there is no hope of any final analysis. Such pessimism might be justified, but even in such a case, a little clarification is better than nought. We are not requesting final definitions, but the ability to explain a little, give examples, identify common traits and find aspects that distinguish a notion from another. This is of great help to read, paraphrase and exemplify.

Students need also the ability to synthesize. It helps to organize different elements or configurations, to find alternatives and to stimulate creativity. The students may find new connectives, logical truths and rules of reasoning to enrich and personalize their logical experience. The temptation to omit such synthesis often comes from considering there is not enough class time or that the students are not prepared to contribute anything original. Some professors have trouble imagining that imagination can be stimulated in a methodical fashion. The notion of a method for creativity might sound contradictory to ears unfamiliar to the many methods used thru the centuries in arts and sciences. Short of making promises of excellence in creativity, we can say many students can be systematically given the power and the responsibility to build their own arguments and even their own logical theories.

Specially important is the logical ability to evaluate things like the reliability of premises, the degree of support they lend to the conclusion, even the elegance of the reasoning. Students should evaluate, for instance, the likelihood of the premises, the certainty of the inference and the plausibility of the conclusion. This ability to evaluate will not be promoted if we skeptically refuse to accept or use criteria for the evaluation. Skepticism is healthy and valuable in the absence of information, but refusing to apply our epistemic capabilities to identify logical virtues of defects is an unjustified form of passivity.

Now we come to the ability to apply concepts and theories to new situations and to use what is learned in a logic course to detect formal structures in daily life, build proofs, find counterexamples, and use logical rules to construct new arguments. This is behind the emphasis in natural language applications we saw in the test for the Olympics since 2004. Being able to apply in daily life what was learned in the logic class helps the student realize logic is useful beyond Academia. The temptation to omit applications might come from the belief that there is no time to do it properly, from the idea that logic is no more than a formal game, or from the viewpoint that logic is an idealization unsuitable for real experience. Keeping logic in the attic of useless trivia misses the opportunity to experience its power to bring light to the world and change life. There is too much darkness around us to devote so much time and effort to construct a lamp that will never be used. Its light is modest and limited, but it is a good step towards clarity. And the application of logic to whatever may be of interest to the students is a golden opportunity for them to confirm that the true object of study in logic is themselves, their thoughts, their musings, their decisions, their world and their impact on others.

How to test

There was no limit to the number of students any particular teacher or institution could enroll in the preliminary phase, or how many could attend the finals. The eliminatory round of 30 "elementary" questions was scheduled for the last week of April and the finals for the second week of June.[7] The finals would consist of another 30 questions, this time at an "intermediate" level of difficulty. The idea was to not discourage participation with excessively difficult tests, and to give participants the month of May to get up to speed for the finals. This worked somewhat since average number of correct answers in the preliminary phase was 15.2 and in the finals 17.96.

Now we have to consider the general question of the construction of good exams and also the more specific question of logical evaluation. The literature on the general question is truly humongous, but there are some general guidelines for academic testing that bear repeating. For instance:

1. Be clear about what you are evaluating. It helps to write down as clearly and detailed as possible the skills to test.
2. Evaluate results, not intentions; we are not measuring attitudes but their effects.
3. Always word the questions in a new way, so the students cannot answer by rote learning.
4. Whatever is worth measuring, is worth measuring objectively. Whenever possible, use multiple choice. It cuts down on other unfair subjective grading methods and time is of the essence when you have hundreds of participants in the Olympics.
5. Be prepared to spend a lot of time designing a good multiple choice test; it requires special care and resourcefulness to measure logical skills. Many teaches give up on objective grading, specially if untrained in this complicated task.
6. Examine the results and go immediately back to the drawing board after each exam. Examined practice makes perfect.

These guidelines might seem obvious or trivial, and so they should. But, in practice, each one of them has encountered bitter resistance from some of the teachers involved, and trying to apply them usually uncovers deeply-rooted pedagogical paradigms at odds with them. The biases and preconceptions in Mexico about testing are pervasive and strong, making each round of logic Olympics both a test of our students and of our own vision on these matters.

Some final suggestions

The design and implementation of this kind of contests will greatly profit from deeper discussions about what it is that we are testing for in the first place. This will also help refine our target public.

I believe we should favor application over mere theoretical proficiency. In the sport Olympic games, theoretical knowledge is not evaluated; what matters is the practice of the sport. In our case, I believe it would be healthy to favor in the Olym-

[7] Most participants preferred the final round to take place at the beginning of June, before the beginning of final exams in Mexican schools.

pics the logic as art over the logic as science. That is, we should be testing mostly the abilities of our students to solve problems via logic. The more realistic the problems, the better, even if simplified or ritualized for the purposes of the games. After all, we do not want martial arts to be really martial when we test the use of a foil, a javelin, a rifle or a hammer during the sport Olympics. We also need a degree of abstraction in our tests of logic, but the motivational potential of these competitions can increase if we make the tests as relevant and similar to real life as is practical.

In a chess tournament, it does not matter whether you are able to beat our opponents thru the application of chess theory learned in chess treatises, or with the mere aid of your natural lights and genius. But almost all participants leave a tournaments motivated to study more about chess, even if that implies mastering its symbolic language and complex theory.

Right now we run the risk of testing our logic students on their mastery of the theory, not on their mastery of the instrument. Of course, we can test music students both on the theory and the practice of music, but the emphasis should be on the application of sound theory to efficient practice. Our students should master the technicalities of mathematical logic but their education is not complete until they can put at least the basic notions of logic to good use in their personal thoughts, no matter how abstract or concrete they may be. The logic Olympics are, first and foremost, a celebration of real life.