IS THE INTERNATIONAL MATH OLYMPIAD (IMO) A BAD INVESTMENT FOR VIETNAM?

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The disappointing performance of Vietnam's team in the IMO this year caused much consternation and a chorus of questions about whether the investment of resources in training a team was being wasted. "The worst performance in 50 years! What a waste!" some exclaimed.[i]

Without over-reacting to a single year of disappointment, I'd like to take this opportunity to try to make a balanced assessment of the pros and cons of the IMO and give some suggestions for the role it should play in encouraging the next generation of mathematical scientists. I'll list several criticisms of the IMO that many people (including me) have made and also suggest some possible solutions.

● *The IMO has always had a bad gender imbalance; girls have been drastically underrepresented on almost all teams, including Vietnam's. The four most recent teams from Vietnam were all-male. (In contrast, this year Australia's team consisted of four girls and two boys.) Part of the reason undoubtedly is the excessively competitive atmosphere during training and the IMO itself (some in Vietnam have likened it to "training for fighting roosters"). That tends to discourage many mathematically talented students of both sexes who are introverted and competition-averse, but it's likely that girls are especially put off by the constant competitiveness not just between teams of different countries but also among youngsters on the same team. Since a central purpose of the IMO is to attract more young people to mathematics, the near exclusion of girls indirectly affects the gender balance in the mathematical professions, in violation of Vietnam's national policy of striving for gender equality.*

In addition to the gender issue, an overly competitive attitude toward solving math problems might actually reduce the likelihood that the contestants will later want careers in the mathematical sciences. The central motive for embarking on a lifetime of scientific work should be satisfaction from the work — in this case from successfully solving a math problem — not from winning a contest.

Some ways to improve the atmosphere in training sessions would be: (a) for the training sessions to discourage direct competition between team members; (b) for the training to alternate between sessions with individual work on practice problems and sessions with each team member working on them with a partner; (c) for the coach to be particularly aware of cases where girls are being ignored or given subsidiary roles in the practice sessions, and to intervene to prevent such cases of discrimination; and (d) for special efforts to be made to invite girls to participate in the practice sessions. Those special efforts could include funding a program of visits by the (few) female former IMO participants to the special high schools for gifted students to talk to the girls there and encourage them to join the practice sessions. Another positive step would be to find a female coach to lead the practice sessions.

The European Girls' Mathematical Olympiad (EGMO) was set up in large part because of past unsuccessful attempts to convince IMO organizers to do something about the virtual exclusion of girls. It started in 2012, and has been quite successful, attracting teams from roughly 60 countries each year. In addition to the IMO, Vietnam should start sending a team to the EGMO, supported by government funding, just as the government supports the (usually all-male) IMO team.

● *The IMO problems are in formal, "pure" mathematics, but in recent years very few of the students intend to be pure mathematicians. Most prefer careers where they work on practical problems and earn higher salaries than pure mathematicians — often in the private sector.*

I agree that the focus on formal mathematics is not appropriate for most secondary school students. For a long time I have argued that Vietnamese

schools should reduce the emphasis on pure mathematics (tricky calculations, tricky algebra, and logically rigorous proofs of theorems) and instead include many more practical applications of mathematics. The reason is not that pure math is unimportant. Indeed, the ability to think rigorously in proving theorems easily translates to successful problem-solving in applied areas. Often researchers trained in pure math later switch their interest to related areas, such as applied math or computer science (as I did many years ago). The world's largest employer of new math PhDs is the U.S. National Security Agency, which has found that young people with rigorous mathematical training are best equipped for the challenges of communications intelligence.

Rather, the reason not to over-emphasize pure math is that most children do not see it as useful, except for the purpose of scoring well on university entrance exams. Typically, even the best students lose interest in pure math once those exams are over and they enter the university. Most students would be more easily motivated for solving word problems (sometimes called "story problems") than for proving theorems.

However, the students who train for and participate in the IMOs are only a tiny proportion of Vietnam's children. They're the ones who are most likely to go into careers where the habits of logical thinking in their pure math training will be particularly valuable. There is no harm and much benefit in the time they spend practicing with IMO-style problems. But the math curriculum in the vast majority of schools should be very different from the math in the IMO training programs.

● *Many of the students who get medals in the IMO end up studying advanced mathematics abroad and then remain in those countries, bringing no benefit to Vietnam.*

The "brain drain" from the poor and middle-level countries to the wealthy countries is a worldwide problem. There are some steps that Vietnam could take to reduce the brain drain in the mathematical sciences. First, the universities should expand and improve their Masters programs. Even

students who want to enter PhD programs in other countries would be well-advised to first get a Masters degree in their own country, since international applicants to PhD programs are usually favored for admission if they already have a Masters degree. Moreover, the additional years of study in Vietnam are likely to cause more of those students to want to return to Vietnam after their PhD, because they will have developed deeper roots in their homeland, perhaps starting a family.

In addition, Vietnam is no longer an impoverished country, and so should improve salaries and working conditions at its universities, which lag behind those at universities in other mid-level countries. Among other benefits, that would cause more of the country's best students to want to come back to teach and do research there.

Immigrants to the West often face difficulties. In the U.S., universities have cut back their research faculty, resulting in a drastic reduction in academic job opportunities for our PhD students. In my university few go on to academic research careers. They apply mainly for jobs in industry or government, and often end up working in areas that are unrelated to their mathematical training. In some cases international students who come to the U.S. for PhDs later find that the best way to get a good job is to return to their country of origin.

The wartime and immediate post-War generation of Vietnamese mathematicians who studied abroad generally returned to Vietnam, despite the extremely difficult material conditions in that time period. Hoàng Tụy, Hoàng Xuân Sính, Huỳnh Mùi, and Nguyễn Đình Ngọc all returned to Vietnam after study in Europe or Japan. They clearly thought that contributing to Vietnam's mathematical development was more important and satisfying than playing a much less important role in some other country.

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Overall, Vietnam's performance in the IMO over 50 years has been remarkably good. The team was among the top 10 countries worldwide in 32 of the 47

years when Vietnam participated. Even during all the hardship of the immediate post-War decade 1975-84, when Vietnam was one of the poorest countries on Earth (classified as LDC by the United Nations), the team scored among the top 10 countries in five of the seven years of participation. Aside from the practical considerations discussed above, we need to think about the intangible benefits of the IMO — the pride and excitement generated inside Vietnam and the prestige on the world stage.

In 1989 my wife Ann and I were visiting El Salvador to inaugurate the Kovalevskaia Prize for women in science that started that year at the country's National University. In her talk to a large group of students and faculty, Ann spoke briefly about Vietnam, a country much admired in Latin America after its defeat of U.S. neocolonialist aggression in 1975. She mentioned that the previous year Vietnam ranked 5th in the International Math Olympiad, ahead of the U.S., which ranked 6th in 1988. The Salvadorans burst into enthusiastic applause. They of course had known about the Vietnamese victory of 1975, but hadn't known anything about Vietnam's achievements in other areas.

Interestingly, one of the reasons for Vietnam's high ranking in 1988 was the gold medal won that year by a secondary school student named Ngô Bảo Châu, who would later become a world-famous mathematician, the Director of the Vietnam Institute for the Advanced Study of Mathematics, and winner of the Fields Medal, which is often called the "Nobel Prize of mathematics".

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Returning to our question — Should Vietnam continue supporting an IMO team? — I would answer "yes" for several reasons. First, the actual financial cost to the government is very small compared to other expenditures for education. Second, the competition generates a lot of interest in mathematics among young people. Third, in most years Vietnam's team performs very well. In addition to showcasing Vietnam's high level of math education on an internatonal stage, another benefit is that Vietnam's high ranking in most years can help counteract the tendency of many youngsters to be overly impressed by Western countries and to think that their country is

inferior to them. Fourth, some of the team members are greatly stimulated by the IMO experience and later choose careers in the mathematical sciences partly as a result. Fifth, most of the deficiencies for which the IMO is criticized are correctable. My hope is that Vietnam will take steps such as those suggested above in order to improve the IMO experience and increase the benefits that come from its investment in the IMO.

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[i] This is an exaggeration. The 2011 team did slightly worse (the same percent ranking, 70%, but no gold or silver medals, whereas the 2024 team got two silver medals), and the 1990 team did significantly worse (a percent ranking of 58% and one silver medal).