Learning from 'physics fights'

James Sharp says that the International Physicists' Tournaments are a great way for students to learn physics

IPT

Problem solving Students participating in the International Physicists' Tournament engage in "doing" physics.

Teachers and lecturers know that students learn better by doing rather than just sitting in a lecture absorbing material. Conventional lecture and lab-based approaches have their place but more self-led approaches to learning are widely acknowledged to help students get to grips with abstract concepts and complex ideas. Having spent years tinkering in the lab and wrestling with unfamiliar theories, I have found that my knowledge has advanced considerably – and at times rapidly – by trying to answer my own research questions. Why then do we not incorporate a more student-led problem-based approach to the way that our students learn physics?

The answer is often related to a lack of resources. Experiments require lab space – and pondering an unsolved problem in an unrestricted way requires time and a certain amount of academic freedom. Indeed, some may argue that provision for this type of learning is provided through undergraduate projects already embedded in the curriculum. However, these projects are often short and focused, and there surely is a better way to encourage a deeper, hands-on learning experience among our students. Perhaps if we set fairly low-level, more open-ended physics problems for them to solve, we could encourage our students to apply what they have learned and to develop into more confident and able physicists?

This is the central idea underpinning the annual International Physicists' Tournament (IPT). As the dust settles on the 2015 edition, which took place in April in Warsaw, Poland, I find myself convinced that it is genuinely an excellent way to learn about physics. The IPT is a competition that is designed to give university students the opportunity to solve open-ended problems and to present their solutions in a series of "physics fights". The tournament has its origins in 2009 in Russia and the Ukraine (which also happens to be 2015's deserving winner). It has since grown to include other countries such as China, Denmark, France, Iran, Poland, Singapore, Sweden, Switzerland and the UK.

Fighting until the end

Preparation for the tournament begins every June with the release of 17 problems by the organizing society. Many of these are taken from everyday life and have usually not been considered in detail in the scientific literature. Recent examples include optimizing the thrust of an ion-propelled aircraft, determining the parameters that maximize the range of a vortex ring in air and designing a thermal clock that has no moving parts. The national teams of four to six students then have until April the following year to solve all 17 problems, to prepare their solutions and to write a short presentation for each solution.

In April the teams converge on the host country to compete in the tournament, which starts with the teams being split into three groups. Each group typically contains three teams from different countries that compete in a series of three physics fights. Each fight begins with a battle between the three team captains who are asked to solve relatively simple physics problems. In recent years these have included tasks such as estimating the area of a piece of paper in units of parsecs^2 or estimating the number of electrons in a piece of chalk. The team with the closest answer wins the privilege of determining in which order they report their solution to one of the 17 problems, i.e. whether they first want to show their solution, oppose the solution of another team or act as a "reviewer" for the two other teams battling it out. If a fourth team is present, then they act simply as observers.

The fights usually involve an in-depth discussion between the opposing team and the reporting team, in which members of the reviewing team add the necessary balance. A panel of judges awards marks based on the performance of each of the teams in their assigned roles. The teams then rotate in subsequent rounds until each team has played each role. The winner of each round is the team with the highest aggregate mark at the end of the three fights. The three winners of the preliminary rounds then enter the final fight to compete for the winner's trophy.

In almost all cases, the solutions to the 17 problems need experiments to be designed and built, as well as the development of a reasonably sophisticated model of the problem being studied. The students then have to present their own solutions, critically reflect on the solutions of other teams and to act as reviewers. As a result of this work, the students become fully engaged in the process of actually "doing" physics, in a way that is not easily achieved within a traditional university setting.

It is clear from talking to previous teams how much they gain from preparing for and participating in the tournament. In fact, they learn more about physics – and what it means to be a physicist – than they do from lectures or laboratory modules. They also report a new-found appreciation for how hard even the simplest-looking problems can be to solve and how much their presentation skills and confidence levels develop.

The UK is a relatively recent addition to the IPT family and it would be great to involve more UK universities in an attempt to establish a national selection process. This is an area where the University Student Network of the Institute of Physics, which publishes *Physics World*, can be – and has been – helping out. So if there are any students in the UK or elsewhere who might wish to take part, we'd love to hear from you.

● See http://iptnet.info for more about the tournament and this year's problems

James Sharp is an associate professor at the University of Nottingham, UK, e-mail james.sharp@nottingham.ac.uk