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*DEVELOPMENT OF INQUIRY-BASED
LEARNING VIA IYPT*



Policy recommendation for YPT

How and why YPT should be supported?



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Policy recommendation for YPT

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We prepare leading researchers and engineers for the 21st century. What is a prominent scientist, engineer, or professional like?

She/he thinks independently and creatively. Able to work in a team, assiduously working to achieve her/his goals. Able to critically examine the results of others and communicate her/his opinion realistically but diplomatically (even in English). Her/his expertise (in the given subject area) is excellent.

International Young Physicists' Tournament (IYPT) is one of the most prestigious international physics competitions. In contrast to traditional problem-solving competitions, here students working in teams and conduct real experimental and theoretical research on open ended physical problems. The main pedagogical goal of the preparation (in addition to teaching physics) is to prepare for teamwork, to develop communication, debate and English language skills, as well as to develop creativity, so it fits very well to the expectations of the 21st century labor market. This is also one of the reasons why about one third of IYPT participants are female.

The next few pages will discuss system of the competition, its effects and current situation in detail and outline what would be needed for further development.

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What is YPT and how does it work?

International Young Physicists' Tournament (IYPT) is a research-based science competition for high-school students. It was born in 1998, long before the community of teachers and didactics professionals became interested in Inquiry Based Science Education (IBSE). Currently students from about 35 countries regularly participate in this international event.

Each summer, IYPT organization publishes 17 mainly experimental open-ended physics tasks. A typical IYPT problem is a description of an interesting phenomenon and students are asked to provide its physical explanation, to find and examine parameters that affect the phenomenon. Students investigate tasks until next summer, when five-member teams present their results at the IYPT world round. Meantime, regional and national level YPT tournaments and selection of the national teams take place.

YPT simulates real scientific work in many ways:

- Teams of students first **look for information about the phenomenon in the literature**, they **consult** with physics teachers at schools and universities. The output of this phase is a **hypothesis** of how the phenomenon works and which **parameters** could affect it.
- Next, students prepare the **apparatus** for observing the phenomenon. The apparatus must be able to change individual parameters independently. The result is **experimental data** that confirm or refute the hypothesis.
- After that, a **qualitative explanation of the phenomenon** is formed and confirmed by experiments, students formulate a **mathematical description** of the phenomenon that explains the measured data. If necessary, students do additional experiments. For very specific experiments they can use also specialized laboratories on universities or research institutes. Such cooperation creates very desirable **links between schools and universities and research institutes**.
- During the competition itself, the student **presents the results of their work** in front of the **opponent and reviewer** from other teams and a **jury consisting of teachers and researchers**. They must defend their solution in front of the **opponent** in the discussion. Another student, **reviewer**, observes the presentation and the discussion and makes a summary at the end. This phase therefore simulates a scientific conference. The performance of the reporter, opponent and reviewer is evaluated by individual members of the jury with grades from 1 to 10. After several rounds, when each team presents solutions to several tasks, the teams are awarded by **medals**.
- The best solutions can be eventually **published in a form of a scientific paper** in a peer-reviewed magazine published by the IYPT. Sometimes, when the solution brings significant new knowledge about the phenomenon, the results are published in **regular scientific journals**.

It is clear that participation in YPT helps to develop not only deep physics knowledge, but also soft-skills such as teamwork and communication.

The next part of this document describes, what hard and soft skills of students YPT helps to develop and how the YPT is supported by governments in different countries. It is based on the results of research carried out by the authors of this document.



What hard and soft skills of the students YPT helps to develop?

Based on a statistical analysis of the views of YPT participants and their physics teachers, participation in the competition significantly helps to develop the following hard and soft skills.

We found that by working on TMF tasks, the following (selected) skills develop better than in traditional teaching or in preparation for other physical competitions:

Hard skills

- Designing of experiments
- Interpreting experimental data, data analysis
- Development of own theoretical model
- Numerical simulations
- Independent research in scientific literature
- Critical assessment of others' results

Soft skills

- Teamwork
- Ability to locate and use information
- Creativity
- Debating skills
- English skills

The results of our research indicate that traditional regular physics classes are highly focused on a very narrow spectrum of skills like solution of close-ended problems or performing experiments based on clear guidelines, while usually a very little attention is devoted to the development of soft skills or of hard skills requiring higher degree of creativity.

Hard and soft skills developed by the participation in YPT are highly valued in modern society and can also be used in areas other than physics. Most successful participants in YPT can be found in prominent positions in research and development, as well as in companies focused to other fields. For example, in the Czech Republic, one of former YPT participants has been one of the few principal investigators of ERC grants.

Therefore, the YPT deserves broad support from all levels of school management, as well as from local governments and companies whose activities depend on highly qualified science and technology professionals.



What helps to organize YPT and to spread it among the schools?

According to the experience of the partners of this project, the following activities help to organize YPT, to prepare the students to the higher level and to launch the YPT in new schools:

- Introductory seminar (on-site or online) for students and teachers led by experts from universities or research institutes, where the YPT competition and current problem set are introduced. Participation of IYPT alumnae is motivating.
- Determined teachers and their support by school management.
- Regular seminars for students and teachers where the progress in solving the tasks is discussed with experts and recommendations are given to students.
- Supportive local universities / research institutes in carrying out experiments. Several universities have special laboratories well equipped for high school experiments (not just for YPT support).
- Regional rounds with simplified rules that make it easier for newcomers to participate in the competition.
- National round with participation of foreign teams and jurors. Internationalization of the national round is very motivating for students and helps to get support from sponsors.
- Support from universities and research institutes in providing jurors for the competition, as well as experts helping the students in preparation or even by providing of premises and technology for the YPT related activities.
- Intensive full-time training of the national team led by experts.
- Support covering the trip to world round of IYPT, as well as to regional international events.

The recommendations above are formulated on the basis of good examples from partner countries. In generally, all partners highly value **dedicated teachers in schools** and **teachers / researchers in academic institutions / research institutes**. Some best practices from partner countries are listed below.

Austria

- Austria has a **regional pre-round for less developed students**, which attracted a lot of attention.
- Because Austria has held **international AYPTs** for 20+ years, **students** who do not get selected into the national team also **experience international flair similar to IYPT**. Similarly, students from foreign countries participating in AYPT receive a **good training for their IYPT participation** in later years. The international relevance of AYPT also **helps raise money from local sponsors**, and **increases attractiveness** for Austrian students to participate.
- Very good **support from universities** in Leoben and Vienna, from **local governments and sponsors**.
- The AYPT offers support for students via a “human reference kit” consisting of **experts**. Students **can ask clarifying questions** when they are stuck or ask for sources that describe a topic they do not understand.



Bulgaria

- The **ministry** provides some support to YPT: organizes the **National competition**, pays the **fee and air tickets** of the teammates and two team leaders, gives partial support to the **preparation** of the extended national team
- They have a **correspondence round** some 20 days **before the National tournament**. Sometimes this **helps to include interested pupils** in existing teams or organize new ones.
- There was an **NGO** that **supported the preparation** of the extended national team. This included: **apparatuses**, materials for setups, travel expenses for **participation in the seminars** of the team or for making experiments elsewhere, **honoraria for the colleagues** engaged with the preparation of the team, **organizing seminars for teachers** acquainting them with inquiry problems and YPT. However, their budget at the moment has passed.
- There is a possibility to use a **laboratory in Sofia University** but nowadays most of the experiments are conducted in a school laboratory.
- An extended national team of 12 pupils is appointed and **every month** we make with them a **weekend seminar**. These seminars are open for all interested pupils and teachers.
- They have **seminars** with the final **national team** in June and in the **days before the departure**.

Czechia

- **Ministry** supports the tournament **financially**.
- The tournament is **officially recognized** by the ministry.
- They get **informal support by leading academic institutions** in physics.
- A set of actions **supporting students** in YPT **preparation** has been established in past few years.

Hungary

- **Ministry** covers the expense of the **international competition** (regardless of the destination).
- Ministry **applications are available** to support preparation (in the order of 10,000 EUR per year).
- The students can use **the infrastructure of the preparatory university** (they can maintain an **own laboratory at the university**).

Slovakia

- The tournament is **officially recognized** by the ministry.
- The **ministry** supports the organizing of the regional tournaments (partly), the organizing of the **national competition**, pays the **fee and air tickets** for IYPT, gives partial support to the **preparation** of the national team.
- **Informal support from universities** in Bratislava and Košice and from **Slovak Academy of Sciences**.

Slovenia

- The Institute for education periodically organizes **conferences for teachers** and invites YPT organizers to give **talks about the competition**.
- Support (not financial) from the **involved institutions**, mainly the "Jožef Stefan" institute.
- In Slovenia, they have a **scholarship for talented students**. Students can receive points for success in competitions.



What do partners consider to be crucial threats for YPT?

Many YPT related activities can be done by enthusiasts. However, the following possible threats are perceived by the project partners as crucial for the continuation of YPT:

- Loss of determined and enthusiastic teachers who are willing to prepare students.
- Loss of financial support from the government and/or sponsors.
- Loss of (non-financial) support from universities and research institutes.
- Loss of experts who are willing to help the students in the preparation and to participate in juries.

How can the government and policy-makers help?

To support the YPT activities and to avoid risks mentioned above, we recommend implementing the following policies:

- Establish a motivation system for high-school teachers to prepare students for the competitions (decrease in lesson load, paid professional training, in-service teacher training, salary top-up, awards). These activities require a lot of time and effort but remain understood, underestimated and non-compensated.
- Recognize IYPT as an International Olympiad, similar to the International Physics Olympiad.
- Establish scholarships / awards for gifted students. For a successful participation on regional, national and international tournament (including YPT/IYPT), students should receive points for scholarship and extra points for college admission.
- Guarantee a continuous financial support for YPT/IYPT that would cover the preparation of students, the organisation of the regional and national tournaments and the travel to regional and international competition.
- The evaluation of competitions should also take into account their complexity. Mostly they are evaluated based on the number of participating students favouring easy and massive competitions, rather than difficult and engaging ones.
- Establish a program for preparation of students that involves academic institutions on an official basis. Academic institutions should be evaluated and financially supported also for their care of gifted elementary-school and high-school students.
- Establish the YPT type competition (in local language) for upper-elementary school students similarly as for Physics Olympiad.



Literature

More information can be found in:

- IYPT web-page <http://www.iypt.org>
- IYPT Toolkit, FÚ SAV, Bratislava 2021, ISBN: 978-80-971975-5-1, available online: http://dibali.sav.sk/wp-content/uploads/2021/03/YPT-Toolkit_EN_ISBN.pdf
- Development of Soft Skills via IYPT, Wirtschaftsuniversität Wien 2022, ISBN: 978-3-200-08423-0, available online: <http://dibali.sav.sk/wp-content/uploads/2022/05/IO2.pdf>,
- Development of Scientific Skills via IYPT, ELTE University Budapest 2022, ISBN: 978-963-489-460-5, available online: <http://dibali.sav.sk/wp-content/uploads/2022/05/IO3.pdf>