Institute of Children and Youth of Ministry of Education, Youth and Physical Culture

10th International Young Physicists´ Tournament

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Introduction

Starosta, L.

The Talentcentre presents itself by the third information brochure. The first information was based on selected contributions presented at the meeting about work with talented children and youth. This meeting, organised in Prague at the end of November 1995, evaluated the results of a long period observation of participants of the competition „SOČ" (Secondary School Special Activity) during several previous years. The second information summarised the activities of the Centre. In the present third brochure, we publish the results of the evaluation of the 10th International Young Physicists' Tournament (IYPT). It also includes information about an interesting and useful project ASTRA 2000. Our close collaborator, Dr. Z. Kluiber, prepared information about the work with talented students in physics. He clearly shows that a tradition of competitions at a given school and the existence of enthusiastic teachers play a decisive role in the preparation of students and in successful participation at international competitions.

The centre was established at the end of 1995 as one of departments of the Institute of Children and Youth of Ministry of Education, Youth and Physical Culture of the Czech Republic. The centre collects and evaluates information about gifted children and youth with the aim to provide the Ministry with suggestions for improvement of future work. The centre is going to be a co-ordinator of various organisations in this field. The centre concentrates on „intellectual talent" and prepares announcements of official competitions in various fields. From these competitions, the centre has obtained necessary information for obtaining an extensive database. This database contains not only the results of about 100 competitions in the Czech Republic, but also data from international competitions. Furthermore, the lists of final results and addresses of competition winners have been collected. The centre has also carried out its own research of gifted children and adolescents.

The centre is planning to extend its activities into an information service and to co-operate with other institutions, in particular with Youth Information Centre, using a server oriented on youth. The centre gives a survey of all competitions organised at the national and regional level on its www page, including all necessary data about these events. These data can serve as a good example for other organisers and participants.

The basic informations are also presented in English.

The centre confirms new forms of organisation of the selected competitions in different regions by means of advanced information technology. These forms can be further extended, assuming that more schools will be included in the computational network.

Project ASTRA 2000

"The economy of the future will always depend on Science"

Rosenkranz, J., doc., M.Sc., Ph.D.

If we look around on our quickly changing society we see that the measure of people's value of success has basically changed. The profession of scientists, engineers or technicians is not as prestigious as the profession of lawyers or economists. Before the World War II, the former Czechoslovakia belonged to the ten most developed countries in the world. We cannot only live from the tradition although we can build on it, if we are able to develop it in creative manner. Decreased interest in natural and technical sciences is not only a Czech problem, but it is a problem of the whole world. In developed countries, this has been solved for several years by investing large financial resources in the education of technical intelligence and for the support of scientific talents not only by the state but also by sponsors. In science development, market is a very inefficient regulating mechanism, whose delayed feedback may even lead to complete destruction of science.

The inspiration of this project comes from the experiences in USA, Israel and Sweden. These countries realised the negative impact of the small interest of young people in natural and technical sciences. They decided not to wait till market mechanisms induce changes in the interest among the young generation from the academic branches to technical and natural sciences. A similar alarming situation also exists in our country.

The foundation of Charta 77 pointed out the relevance of this problem in our country and provoked a group of specialists to declare the project ASTRA 2000. The project is divided into four main sections (secondary schools, universities, post-graduated students, technical universities and the Academy of Sciences of the Czech Republic). A committee of the project was created from the top scientists - members of the Academic Board of the Academy of Sciences, vice-rectors, vice-deans and further experts from practical fields of applications.

The aim of this project? The aim is to increase the interest in education in the field of natural and technical sciences among young people, the popularisation of science and technology, the organisation of education, the support of talented students and beginning scientists. The collaboration among universities and secondary schools, the Academy of Sciences and industrial companies to organise training activities could enhance the interest of young people about natural and technical sciences and could support talented students and could help in the systematic education of future experts.

Activities of the project ASTRA 2000.

I. The Secondary School branch.

In the sphere of high schools the project is namely focused on the teachers who teach subjects from the field of natural and technical sciences. By means of summer schools where top experts from universities and institutes of the Academy of Sciences will lecture; the teachers will obtain new knowledge from the different scientific branches. They can then use this in teaching and make their teaching more interesting. Summer schools will contribute to the connection of closer personal contacts not only among the teachers of individual schools but also with lecturing experts from universities and the Academy of Sciences. The contact addresses of universities and the Academy of Sciences will be given in all lectures so that the participants of the summer schools can find working places of individual experts.

Excursions for the participants will be arranged within the frame of the summer schools at various faculties and institutions of the Academy of Sciences according to specialisation.

General, the aim of the project is to offer to the organisers of lectures and seminars the experts of specific branches of science from universities and institutions of the Academy of Sciences. In the case that students and school boards are interested, we offer the opportunity of excursions to interesting expert laboratories and working places in faculties and institutions of the Czech Academy of Sciences.

We intend to organise summer schools for talented pupils from secondary schools. They will obtain information about latest interesting discoveries in the field of natural and technical sciences. They can thus come into closer contact with scientific and research work. During summer schools one-day excursions will be organised to institutions of the Czech Academy of Sciences and to faculty laboratories of the University.

II. The University branch.

At the university level, the project plans to provide scholarships for six months at foreign universities and specialised institutions. To increase the number of students studying selected branches, we will invite applicants according to the sponsors' wishes. We intend to reward the best theses in chosen fields of natural and technical sciences.

III. Post-graduate students' branch.

In the sphere of the post-graduate student studies the project is focused on formulating the goals. The themes of dissertation theses will be set in advance. We want to give scholarships for stays at foreign universities or at other expert working places and provide financial support for attendance at international conferences. The post-graduate students will have an opportunity to present their results of the dissertations. We want to give some financial support and to reward the post-graduated student works at the faculties organising conferences, where the best dissertations will be presented. If there are financial means we will organise the whole republic conference for the post-graduated students from the field of the natural and technical sciences. The best works will receive a financial reward covering a visit of a foreign scientific laboratory.

IV. Support of the collaboration with the Universities and the Academy of Sciences.

We will give some financial support for creating new scientific-pedagogy teams.

Many large enterprises from the sphere of engineering, chemistry and power engineering have a lack of young technical workers. From these reasons some enterprises begin to collaborate with faculties. But we suppose that the most important is to focus to secondary schools because there is the place where young people decide which branch or specialisation they will study and the teachers at the secondary schools have the greatest influence on their decision. Further it is the perspective of valuable future employment and good economic conditions. There is a need to show this possibility to young people and to show their perspectives when applying their own knowledge. Also universities and the possibility of post-graduate studies can increase the interest for specialisation and thus increase the quality of future experts. The firms will also have the opportunity to choose from a larger amount of applicants.

Young people like to compete and so it is very useful to organise conferences for them where they can present their results. We hope that this will increase the interest to study these branches and specialisation's at schools, where these activities will be performed. Good examples are different competitions at secondary schools as the Young Physicists' Tournament, Physical Olympiad, Postcard Competition, The Student Scientific Conferences, etc. It is also important to organise student scientific or post-graduated conferences at universities or to organise the whole republic conferences in the selected branches. There will also be a good opportunity for sponsors and firm presentations.

As was said above, many firms begin to collaborate with the universities. These activities are very useful and profitable for the development of given branches and specialisation in the given region. The board of the project ASTRA 2000, which consists of vice-rectors, vice-deans and representatives of the Academy of Sciences, supposes that the most efficient would be to concentrate all financial contributions from the firms towards the activities that are focused to increase the quality of education and the number of graduates from technical and natural faculties. The project ASTRA 2000 is the place where these means should be concentrated. We will support mainly the activities in the secondary schools because there is a limited amount of the financial contributions from sponsors. We suppose that such effort is the most important.

Therefore, in the year 1996, the project was specially focused to the secondary school sphere. The first summer school form was arranged for the teachers teaching the natural and technical sciences. The form was held at August 26-30 at the castle Štiřín near Prague. The project board chose twelve themes that covered the whole area of natural and technical sciences. Here the experts from universities and the Academy of Sciences talked about the last discoveries, explorations and achievements in the field of natural and technical sciences. Visits of the chosen institutes in the Academy of Sciences and of the two universities were important parts of the summer school. Information of secondary school teachers about the latest discoveries from selected scientific branches was the goal of this summer school. We also want to stimulate personal contacts with the top experts from the Academic institutions and universities. The secondary school is exactly the place where the students decide what they will do in the future. Therefore the personality of teachers, their enthusiasm and attractive explanations can substantially influence the decision of young students what university they will study. The adviser of the school board's ministry Mr. Hynek Kratký and vice chairman of the Academy of Sciences Prof. Václav Pačes, DrSc, took part at the beginning of the summer school. Prof. Rudolf Zahradník, DrSc., chairman of the Academy of Sciences also visited the summer school. The financial expenses were covered mainly from the means of Phare program (about 20.000 ECU).

According to the outstanding evaluation of the summer school by their participants we decided to organise it again in the next years.

The project ASTRA 2000 also took part in the organisation of the Postcard Competition „The natural sciences for all" for the secondary school students. 120 pupils from the secondary schools of the whole Czech Republic took part in this competition in the school year 95/96 and 320 in the school year 96/97 that confirms an increasing interest among pupil. A seminar was organised for 40 most successful participants in the recreation object of Masaryk University Brno at September 14-17, 1997. The seminar also contained discussions with experts about interesting physical problems. The problem of studies at natural and technical faculties was also discussed.

This competition is organised in four subsequent parts each year. The competition tasks are sent to the participants at regular intervals, the solutions are corrected and sent back together with model solutions and discussion to the most frequent mistakes. After each part of the competition, the running order off all participants is evaluated.

In the year 1997, the project ASTRA 2000 shared in the organisation and arrangement of the 10th International Young Physicists' Tournament, which took part at the secondary school at Cheb on 1st to 7th June 1997. The Young Physicists' Tournament represents very difficult secondary school student's competition. Five member teams represent, contradict and review the solution of 17 physical problems by the form of scientific discussion. Students are publicly defending their solutions before the independent evaluating committee.

The offer to organise the 10th anniversary form in Czech Republic is also an evaluation of excellent results of our students in the last five forms. They received three times the first place, once the second and once the third place. Eleven countries took part in the form this year. Prof. Klaus von Klitzing, Nobel's prizewinner for the year 1985 and Prof. Herwiq Schopper, long year Cern chief, were the main guests of the 10th International Young Physicists' Tournament. The lectures of Prof. Klitzing, Prof. Schopper, RNDr. J. Grygar, doc. Kleczek were the main part of the expert accompanying programmes. During the 10th International Young Physicists' Tournament, CEZ Company arranged the whole-week exposition "Energy for everyone." The all participants of the competition as the best in the ten-year history evaluated this year form.

This activity became the significant contribution to further development of talented students in physics, to the presentation of Czech physics and to active publicity of the Czech Republic.

The project ASTRA 2000 of the Foundation Charta 77 in the collaboration with the Centre of further education of teachers at Masaryk University Brno arranged in the education centre Šlapanice the Autumn school Šlapanice 97, held on October 25 - 30, 1997.

The participants were the secondary school teachers from the whole Czech Republic with the teaching qualification in mathematics, physics, chemistry and biology. During the opening ceremony, the participants received proceedings of all lectures with contact addresses to the individual expert working places at faculties and the Academic institutions. The participants took part in 14 lectures of the top experts from the universities and the Academic institutions. The lecturing experts were the Academy chairman Prof. Rudolf Zahradník, RNDr. Vladimír Dvořák, the director of the Institute of Physics of the Academy of Sciences and the dean of the Faculty of natural sciences Prof. Karel Štulík of the Charles University, Prague.

In the course of this activity, two excursions were arranged. The first one was aimed to the Academic institutions that are found in Brno and the second to universities in Brno. The participants visited the biophysical institution, the institution of analytic chemistry, the institution of measuring instrument, where there visited some scientific working places. Vice-rector of the Technical University Brno, doc. Pavel Dub and the dean of the Faculty of mechanical engineering Prof. Jan Vrbka, the vice-dean of the Faculty of electrical engineering, dr. P. Jura and the vice-dean of the Faculty of natural sciences of the Masaryk University doc. J. Celý, welcomed the teachers. The representatives of individual faculties informed the participants of the Autumn school Šlapanice 97 about their scientific activities and about the opportunity of studies at the Technical University and the Masaryk University. They also visited scientific laboratories of the Faculty of mechanical engineering.

The goal of this meeting was not only to acknowledge the secondary school teachers with the latest discoveries from individual scientific branches, but also to stimulate personal contacts with the top experts from the Academic institutions and universities. This can improve the communication among secondary schools, universities and the Academic institutions.

In the final discussion, the participants highly evaluated the level of presented lectures and the good organisation of the school. Also the cultural surroundings of the centre Šlapanice was rated very highly. During the discussion all participants expressed their request to continue in this activity in the future. This school gave them new encouragement and energy for their further studies. They expressed their willingness to devote their free time on Saturdays, Sundays or during holidays to the same activity; they proposed to arrange the 3rd term of the Autumn school Šlapanice '98 for the secondary school teachers in the same time and at the same place.

We can say that the project ASTRA 2000 achieves the greatest success in the sphere of physics. The Gymnasium in Prague 5, Zborovská street 45, a model school, where we can see how the collaboration between secondary school and universities or the communication with the Academic institutions should be. We found here an enthusiastic teacher of physics Prof. Zdeněk Kluiber, CSc, who devotes himself to his students for many years. He knows how to raise and educate the talents as his team won four times the IYPT competition within last six years. The experts, mostly from the Institute of Physics of the Academy of Sciences and the university teachers are invited to lecture the interesting result of their work to the students at this school. Under supervision of Prof. Kluiber, CSc and the director of the Institute of Physics RNDr. V. Dvořák, DrSc, there are arranged physical student scientific conferences for many years. Scientists from physical institutions and the Czech Technical University teachers help students as consultants with the solution of different physical problems. At this school due to the initiative collaboration of Prof. Kluiber with the project ASTRA 2000, they successfully fulfilled all aims that project ASTRA 2000 has as its goal. The great part of these students wants to attend studies at the natural or technical faculties, where they have reached very good results. Parallel to this, we want to find another secondary school as e.g. their secondary school at Cheb where the teachers try to get the interest of their students in the natural branches, and to find further schools where enthusiastic teachers may be found and who know how to get the students for their subject and not only in the physics, but also in the mathematics, chemistry, biology and other technical and natural branches.

Finally it can be said that the ASTRA 2000 project has been an event where experts from universities and scientists from the Academy of Sciences met in order to help to support new talented young people from secondary schools which can consequently increase the interest of these young people for the university studies. The secondary school itself is the place, where the young people decide which specialisation they will study at the universities. The decisive influence on this solution where and what they will study has the personality of their teacher, the way of problems explanation, perspectives of future work and certainly economic conditions. The source of the effectiveness of the economical development of the country, like the Czech Republic, which has not important natural resources, is education of the people, especially in the natural sciences and technical disciplines. The interest for the study of these disciplines is not sufficient enounce, there is a lack of the sufficiently qualified applicants for the study of technical disciplines.

If the corresponding actions to increase the number of good candidates for university studies are not undertaken, it may happen that the Czech Republic can become only an assembling factory in which products will be mounted form imported components.

All the activities of the ASTRA 2000 project are, however, limited by the financial costs. If this project has to fill its task it must last at a certain time.

The CEZ Company is up to now, one of the companies with which we have an excellent co-operation. This company perfectly understands that our state has not sufficient means to support extra activities in the education of young people.

„Science is at present a basic milestone of the development of each country in spite of the fact how the country is rich. The science in the future will play more important role in the economy of the country", was said by Mr. Jeffrey Sax, professor of the economy at the Harvard University, USA.

Students Preparation in Physics in the Czech Republic

Kluiber, Z., RNDr., PhD.

Introduction

Recognising and developing talented students at the high school level is one of the most important objectives connected with preparing future scientists, professionals and physics teachers. The decision of a high school student as to the direction of his or her future study or job specification must come out of an equivalent acquaintance with qualified work in the field.

For talented secondary school students, who have decided to become physics scientists or university or high school physics teachers, it is important that during their high school study they become familiar not only with scientific findings in physics (at the high school level) but, more importantly, to have *an opportunity to work creatively and simulate the work of scientists or teachers.*

For a technical future and consequently for the economic future of the Czech Republic, physics, chemistry, molecular biology and computer sciences, as well as technical sciences, are essential. Representatives of the Charta 77 Foundation, the Czech Technical University in Prague, the Academy of Sciences of the Czech Republic and the Charles University has issued a joint statement in which they turn to politicians, deputies, government representatives, scientists, university and high school teachers, bank and company representatives as well as entrepreneurs. They have the following goals: *to help with searching and developing talents for Czech science and technology*, to help to raise science and technology, to support successful work with teenagers, to promote various forms of intensive penetration of the latest scientific findings into searching, education and developing talents for science, into a social life [1]. The tasks stated above are realised in Charta 77 Foundation's project called „ASTRA 2000". This program is divided into four fields: talented students at high school, excellent university students, directed support of postgraduate study and relationships between universities and institutes of the Academy of Sciences.

The basic findings of physics didactics show the importance of maintaining these objectives:

1. students must be enabled to do their own creative work,
2. students should acquire experiences when solving simple investigative problems within a team of solvers,
3. it is necessary to include individual study of technical and scientific literature into the teaching process,
4. students should acquire experiences from studying appropriate foreign literature,
5. it is appropriate to encourage student contact with scientists to obtain actual information,
6. to develop qualified individuals by suitable selective seminars,

7. to enable students to learn forms and methods of scientific work, to present obtained results,
8. to develop conditions that allow students from various extracurricular activities to meet together,
9. the physics curriculum should also include, at a suitable level as an important motivational tool, findings of modern physics,
10. To teach students the ability to sort and evaluate obtained results.

When obtaining and analysing data mathematics and computers are widely used therefore modern equipment and experimental devices are of the highest importance.

Secondary school students may participate in four physics competitions or exhibitions: the Physics Olympiad, Secondary School Special Activity in the Field of Physics, Young Physicists' Tournament and The First Step to the Nobel Prize in Physics. Participation in any of these competitions, *according to the individual specialisation* of each student, is good preparation for studying physics at university. The primary importance of these competitions is to show the work of a physicist, to promote inventions and to broaden students' physical thinking.

It is necessary to obtain suitable problem formulations from physicists, qualitative as well as quantitative, which will promote students' interest in physics.

School Physics Teaching

An important task of a high school is to intensify individual work with talented students. The fulfilment of such a task includes individual education with respect to the abilities of each student. The student's activity should develop form his or her own needs with a goal to fulfil one's own self-realisation.

On the other hand, the background in which it is possible to lead students to successful results cannot be neglected. No doubt, school background, which assures suitable conditions for such an activity, is vital to this process.

The main condition for the first stage of work with talented students is intense teaching of physics with the whole class.

Only on the basis of *the particular work of a student,* is the teacher able to determine features of talented physics students.

Correct solutions to written examinations, exact analysis of physical phenomena in oral examinations, reports on interesting topics, experimental skills, proper interpretation of obtained results and tokens of physical thinking, all enable us to identify talented physics students. On the basis of this experience, the teacher can evaluate what is the best competition or direction of individual preparation for each student. But the teacher must *talk* to such students! He must know him or her personally from professional and moral points of view, from the point of view of his or her expected study specification, as well as from expected occupational orientation.

A concrete example of systematic work with talented students are the agreements realised between Gymnasium, Zborovská, Prague and Institute of Physics of the Academy of Sciences of the Czech Republic and between Gymnasium Zborovská, Prague and the Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague. The basis of the agreements lies in long term participation of students in solving specific problems posted by the Institute of Physics under the leadership of scientists, in consulting university teachers of the Faculty of Nuclear Sciences and Physical Engineering. A condition for leading such students is their detailed acquaintance with creative investigation when solving a problem. Students become familiar with the latest findings, learn to work professionally and individually, obtain experimental experiences and use real scientific equipment. Students are in personal contact with scientists and university teachers, who treat them as co-workers. It is obvious, that such contacts may become *the decisive factor in a student's life orientation.* It is characteristic for these students that they understand the opportunity to work with prominent scientists as a matter of great value, which fills them with satisfaction and corresponds to their needs to cognise and create. Special importance for actualisation and intensifying school curriculum are the lecture topics presented by scientists from the Institute of Physics and the Faculty of Nuclear Sciences and Physical Engineering within the framework of the „Modern Physics" seminar held by Gymnasium, Zborovská and students' excursions to selected laboratories. Lectures promote students' interest in the field of modern physics and complement the curriculum to the borders of today's knowledge itself. Both institutions have provided Gymnasium, Zborovská with technical materials and also some discarded equipment, which are used mainly in preparation of students for physical competitions.

Important results of high school students' work at the Institute of Physics and other workplaces were subjects of unique student conferences in physics held by Gymnasium Zborovská, Prague and the Institute of Physics. *At the conferences students presented obtained results in the presence of consultants – the work leaders.* Among participants of the students' conferences were also winners of nation-wide competitions as well as successful representatives of the Czech Republic in international physical competitions.

Physical Competitions

Developing of talented students in physics comes out of good school physics teaching and following extra-curricular activities – especially physical competitions as well as other physical activities.

When participating in physical competitions, high school students develop their abilities and skills as a fundamental condition for their future work in physics.

a) Physics Olympiad

The Physics Olympiad, founded in 1959, is among the best proven forms of work of developing talented students in physics. This statement is confirmed by practical results of participants of the Physics Olympiad (now scientists, university and secondary school teachers).

Although solving physical problems is the basic form of work with contenders, the competition itself should be a summit of long term activities of students interested in physics.

Besides problem solving, participants of the Physics Olympiad must also be well prepared in the field of experimental physics, as well as in the field of qualitative data analysis.

So this activity with talented students is remarkably based on long term teacher - student co-operation, a system of professional physical seminars, regional and national meeting of students, Physical Olympiad clubs at schools, correspondent seminars, etc.

b) Secondary School Special Activity in the Field of Physics

Secondary School Special Activity (SSSA) is a unique meeting of students from the Czech and Slovak Republics. It was founded in 1978. SSSA enables individual development according to individual interests of students, promotes talent development and creates opportunities for students to express their abilities and talents.

The basic features of SSSA: according to particular interest or on the basis of teacher or consultant's recommendation, students work on written solutions – approximately 30 pages long + appendices (up to 200 pages) – of selected objects or topics and they publicly defend their written work. One or more students do the work.

Consultants and other beholders through expert judgement opine the written results.

Students can solve only the problems they, as high school students, are able to deal with. Participation in SSSA is a significant contribution to professional development of talented students, especially those who have particular interests in specialised fields and have devoted a great deal of their free time to them.

The role of a consultant is, in many cases, not substitutable. Only he can enable students to work with highly specialised equipment, he has the latest information about the problem at his disposal, he may suggest the right approach to the problem, discuss all questions concerning the topic in details: so the consultant doesn't solve the problem for the student, but leads him or her in the work.

c) Young Physicist's Tournament

The Young Physicist's Tournament (YPT) was founded around 1979. Since 1988 it has been held on international level [2].

YPT is a competition of teams of high school students. It proves their abilities to solve difficult physical problems and present their solutions in a form of scientific discussion – „physical fight".

1. Each year 17 problems are formulated with topics resulting from physical experience as well as wide possibilities of applying physical methods in technology, natural sciences, economy, healthcare or sport [3].
2. Each team is comprised of a five-member group of students with a leader – their physics teacher.
3. To qualify in the tournament itself, it is necessary to prepare written results at first; the concept of the problems is that nobody knows their exact results.
4. The tournament proceeds according to precisely stated rules.
5. At the international YPT, teams, which have usually qualified in national finals, compete.
6. The languages that are used in the international YPT are English and Russian.
7. YPT significantly promotes students' abilities in professional work in physics and their language skills.

Stages of the competitions are as follows (procedure used in the Czech Republic): first, five-member teams are formed at schools (even from various grades). Their physics teacher, as a team leader, provides them with support and leads them in their work. By virtue of the written results, the best teams are chosen and invited to the national final. During the finals team representatives progressively meet in „physical fight" according to a scheme of „REFERENT – OPPONENT – REVIEWER". The winner of this final qualifies for the international final.

The Referent, based on a problem chosen by the Opponent, presents an essence of a solution with respect to the main ideas from a physical point of view; introduces prepared pictures, graphs, overheads, photos, etc. The Opponent gives his or her opinion on the main ideas of the report and criticises them. The Reviewer presents an evaluation of the Referent and Opponent's contributions. In the polemic, which goes throughout the whole round of the competition, all opinions of contenders are discussed in detail.

An evaluation committee evaluates public performance of the students by assigning marks. The evaluation committee (at the international, it has YPT up to fifteen members) has to judge objectively the professional level of the solution and the discussion.

Benefits from participation in YPT primarily consist of:

- working in a team of enthusiastic solvers,
- solving specific problems in physics and other sciences connected with physics,
- doing an analysis of a problem and determining physical phenomena that are closely related to the problem,
- studying literature intensively, especially in foreign languages,
- consulting a problem with scientists and professionals,
- making an optimal model for solving a problem,
- preparing and constructing particular experiments and equipment,
- obtaining and processing specific ideas for the solution at specialised institutions,
- acquiring habits equivalent to an approach of scientific conference, to debate meaningfully, to criticise and evaluate advantages and disadvantages of competitors' solutions,
- significant broadening of their language skills,
- making contacts with their potential future fellow-workers,
- learning how to publish the results of their work.

In the last six years of the International YPT, teams from the Czech Republic have won these placements: first, third, first, second, first and first.

d) First Step to the Nobel Price in Physics

The Institute of Physics of the Polish Academy of Sciences founded the competition in 1993. Its participants send to this institution, in a given term, their twenty-page work in English with a physical theme of their choice. The work usually includes interesting and valuable results; the institution's scientists review all. Authors of the best works – the category of Winners – are invited to a four-week stay in the institute. They become familiar with the work of the Institute of Physics of the Polish Academy of Sciences, with specifications of its scientific sections, they participate in some experiments and they get to know Warsaw and Poland. Other categories of evaluated works are Scientific Works, Contributions, and Apparatus.

e) Student's Publications

When working with talented students in physics, special attention needs to be paid to *the presentation of results* of their activity. If students are successful in some competitions it is necessary, that they present basic findings of their work either in writing – which is more difficult, but more important for the students – or orally in front of their schoolmates and teachers.

Talented students obtain first hand experiences from their own publishing. (Indeed, when they are able to write multiple-pages work or problem solution).

Excellent themes or topics for their next work (and also publications' topics), talented students may obtain at various seminars, meetings with scientists, from their physics teacher, at international exhibitions, at study stays and from information obtained on physical institutions, etc [4].

Conclusions

Searching and developing talented students in physics demands much of the physics teacher.

The development of talented students evolves from good teaching of physics and extra curricular activities that follow physical competitions as well as other physical activities.

Students acquire and develop their abilities and skills as a primary condition for their future work in physics. In the system of their preparation, a suitable presentation of their results also has an important place.

Communicative skills also have an important place in talents' development, with respect to international actions and mainly immediate contact with physicists.

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The research performed during the 10th IYPT

Hoffmann, O., M.Sc., Fišer, J., Kluiber, Z., RNDr., PhD.

Questionnaire for team leaders

A. Country: Russia 3, Czech republic, Ukraine 2, Belarus, Georgia, Hungary, Poland, Slovakia, Sweden, Uzbekistan 1; fully 15 (100 %).

B. First name and family name:

C. Sex: a) male 9
b) female 6

D. Your team is:
a) winner of YPT in your country 8
b) composed of the individuals as based on the national YPT results 0
c) composed another way; how: selected in seminars 1
selected in Olympiad 2
unindicate as 2
d) no answer 2

E. What was your preparation for YPT ?
a) none 1
b) at school only 3
c) at school with aid of experts from (universities, Academy of Sciences, etc.) 6
d) at school and at special institutions (universities, Academy of Sciences, etc.) 4
e) on special institutions only (universities, Academy of Sciences, etc.) 0
f) no answer 1

F. If your team on the International YPT is a national YPT winner, tell us something about the YPT tradition at your school. How many years has YPT been held:

1 - 4 years	1
5 - 7 years	4
8 - 10 years	2
more	1
never	4
no answer	3

G. Did you have a preparatory meeting before the International YPT?
a) yes 12

days	count
2 - 4	3
5 - 7	4
more	4
state not as	1

b) no	2
c) no answer	1

H. If so, it was financed:

a) fully	5
b) partly	4
c) in full by participants	3
d) out of charges	1
e) no answer	2

I. If so, it was focused:

a) mainly at language preparation	0
b) at language preparation only	0
c) mainly at physics	2
d) at physics only	4
e) both at language and physics preparation	6
f) no answer	3

J. If your team is a winner of the national YPT (from one school only), try to estimate the financial expenses (in your currency) for the preparations and solutions of the tasks for the whole team, without travel expenses to the place of the competition:

a) none	1
b) to 100 $	3
c) to 500 $	3
d) to 1000 $	1
e) do not care	4
f) no answer	3

K. The above mentioned expenses have been covered:

a) by competitors fully	2
b) by competitors partly	2
c) by someone else	5
d) no answer	6

L. Who supported the team financially:

a) sponsor (sponsors)	3
b) the school	3
c) another institution	5
d) no answer	2

M. What is the greatest enrichment from YPT for students?

a) language	5
b) experience with teamwork	5
c) development of physical thinking, cleverness of experiments, application of mathematics	2

d) original work 2
e) enthusiasms and motivation for hard-work in physics 2
f) development of communicating abilities 1
g) no answer 6

N. How can YPT be improved - both in content and organisation?
a) move strict rules 2
b) international organising comity must help to the local organising committee 1
c) it would be better to concentrate the attention on physics, not on the language 1
d) the jury should understand English 1
e) more time for discussions 1
f) change the jury evaluation system 1
g) development of teachers in the schools - financial evaluation 1
h) more popularise tournament in schools 1
I) no answer 5

O. What do you regard as important for yourself from your participation at YPT or the International YPT?
a) building-up efectivity, proffesionality, methodology 9
b) juxtaposition with the others, high motivation for self-culture 3
c) no answer 3

P. How much time did you give personally to YPT?
a) 80 hours 1
b) 150 hours 1
c) 1000 hours 1
d) many 1
e) no answer 11

Q. What other competitions in physics are organised in your country?
a) Physics Olympiad 11
b) Young research 5
c) conferences in physics 5
d) others national competitions in physics 3
e) International festival in mathematics and physics 1
f) no answer 2

R. State their order of importance

PO			YR			conferences			others		
1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
8	1	0	2	1	1	0	1	2	0	2	0

no answer 5

S. What should be emphasised, in your opinion, in physics studies at school for talented students?

a) international contacts 4
b) activities in physics, experiments, problems 2
c) individual attitude 2
d) teacher work 1
e) integration theory and praxis 1
f) experimental activity 1
g) instruments - mathematics, language, team-work 1
h) material-technical basis 1
i) financial development for students and teachers 1
j) no answer 2

T. What is, in your opinion, the role of a physics teacher in searching for and developing talented students in physics studies at school?
a) main role 4
b) motivation 2
c) like start impulse 2
d) to give the best possible example 1
e) as a guide, how to work, what to read 1
f) presentation with significant form of physics, account of methods, opens the questions 1
g) fellow-worker of the students 1
h) no answer 3

U. Have you been supported by administrative bodies (country, local, etc.) as regards YPT?
a) yes 11
b) partly 2
c) no 1
d) no answer 1

V. This support consists in:
a) fewer teaching hours 0
b) financial support 7
c) material equipment 2
d) other 3
e) none 1
f) no answer 2

W. Do you publish something about YPT, or the International YPT? If you do, what is the form of publication?
a) brochure 5
b) journals 1
c) no 5
d) no answer 4

X. Will the solution of some of the 10th International YPT tasks be published in your country? If so, in what way?

a) yes	9
b) journals	3
c) brochure	4
d) state not	2
e) do not - hopes	2
f) no	4

Y. What publications on the International YPT do you know?

a) publications	6
Kluiber, Z. et al.: The Development of Talents in Physics	3
title state not	3
b) none	8
c) no answer	1

Z. How many teams, in your opinion, should represent one country?

a) 2 teams	5
b) 1 - 2 teams	3
c) only 1 team	3
d) 2 - 3 teams	1
e) it depends from concrete organiser's situation	1
f) all clever teams	1
g) as is written in the rules	1

Questionnaire for students

A. Country: Russia 15, Czech republic, Ukraine 10, Belarus, Georgia, Poland, Slovakia, Sweden, Uzbekistan 5, Hungary 2; fully 72 (96 %).

B. Sex:	a) male	69
	b) female	3

C. Age:

a) 16 and less	10
b) 16 - 17	46
c) 18 - 19	15
d) 20 and more	1

D. Is your school (class) specialised?

a) yes, school - in mathematics and physics	26
b) yes, class - in mathematics and physics	27
c) yes, but in other areas	8
d) no	11

E. Is there an YPT tradition at your school? How many years has YPT been held at your school:

a) 2 - 5 years	3
b) 5 years	9
c) 6 - 9 years	23
d) 10 years	12
e) more	5

F. How many times have you been engaged in the National YPT?

a) once	42
b) twice	14
c) three times	9
d) National YPT hold not	5
e) no answer	2

G. Who was your tutor for the preparations and solutions of tasks? (State his/her profession only, not his/her name)

a) teacher of physics	42
b) physicist (from university - inclusive father - 2)	16
c) students of physics from university	5
d) other physicist	5
e) none	2
f) no answer	2

H. Have you been supported during the preparations and solutions of tasks by your older colleague students?

a) yes	34
b) no	34
c) no answer	4

I. The team, in which you take part in the competition, is:

a) winner of the National YPT	57
b) composed of the best individuals as based on the National YPT results	6
c) composed in another way	7
d) no answer	2

J. What is your main role in your team (how you have been most useful to your team)?

a) as a theoretical physicist	38
b) as an experimental physicist	33
c) as a programmer, a mathematician	22
d) as a linguist	15
e) no answer	1

K. What preparations for YPT did you have?

a) none	1
b) at school only	14
c) at school with aid from experts (from universities, Academy of Sciences, etc.)	26
d) at school and at special institutions (universities, Academy of Sciences, etc.)	19
e) at special institutions only (universities, Academy of Sciences, etc.)	10
f) individual	1
g) no answer	1

L. Have you had a preparatory meeting before the International YPT? If so, for how many days and to what it was focused:

a) mainly at language preparation	2
b) at language preparation only	0
c) mainly at physics	13
d) at physics only	15
e) both at languages and physics	23
f) other	2
g) number days	

2 - 4	9
5 - 10	7
14	14
20	5
30	5
more	1

h) none	17
i) no answer	4

M. How many times you took part in the International YPT?

a) once	62
b) twice	4
c) three times	1
d) no answer	5

N. Taking part in the International YPT:

a) has been covered in full by you	8
b) has been covered partly by you	14
c) has been covered in full for you	44
d) no answer	6

O. What, in your opinion, should be made better in the content and an organisation of the International YPT?

a) only English	22
b) explicit rules	15
c) constitution of the jury	9

d) more time for a discussion 3
e) all OK 8
f) out of answer 12

P. Put down numbers of tasks at 10^{th} IYPT, which seemed to you:

number	a) too easy	b) too difficult	c) interesting	d) wrong
1	7	4	18	14
2	3	9	30	0
3	8	10	16	5
4	0	17	29	2
5	8	7	28	6
6	3	14	25	3
7	1	11	11	3
8	7	11	17	1
9	5	8	20	1
10	1	7	25	5
11	0	9	24	1
12	9	9	16	2
13	0	12	18	3
14	8	4	23	1
15	2	6	14	6
16	11	8	21	0
17	10	3	19	8

all apposite 4
no answer 5

Q. Have you had any possibility to use the solution of some of YPT and/or IYPT tasks out of these competitions? If so, describe where and how

a) yes (inclusive on the conferences 5) 10
b) no 43
c) no answer 19

R. What physics competitions are organised in your country?

a) Physics Olympiad 53
b) conferences 12
c) projects or other students activities in the field of physics 11
d) 1^{st} Step to the Nobel Price in Physics 1
e) none 4
f) no answer 13

S. State their order of importance:

order	PO	other activities	conference
1.	22	1	0
2.	16	2	5
3.	2	7	2

a) state not 18
b) no answer 31

T. Do you take part in other competitions (olympiads) in your country? In which area?

a) biology 8
b) chemistry 11
c) physics 59
d) mathematics 49
e) other 28
 informatics 11
 English 9
 history 5
 German 2
 astronomy 1
f) none 2
g) no answer 3

U. Are you interested in any areas besides physics (also non-academic)?

a) informatics 17
b) mathematics 16
c) languages 11
d) sport 8
e) economy 5
f) history 4
g) chemistry 4
h) biology 3
i) electronics 2
j) philosophy 2
k) music 2
l) geography 2
m) psychology 1
n) medicine 1
o) no answer 4

V. Will you continue your studies at any university? If so, what type of studies?

a) the University 61
b) other - the technical universities 6

c) no answer 5

W. What area will you study?

a) biology		3
b) chemistry		4
c) physics		32
d) mathematics		21
e) other		10
computers	4	
economy	3	
law	2	
medicine	1	
f) does not know		2

Questionnaire for observers

A. Country: Germany 4, Singapore 2, Sweden 2, Czech Republic 2

B. First name and family name:

C. Sex:	a) male	8
	b) female	2

D. What do you see as the main contribution of YPT or IYPT to the students?

a) students can see professional work of scientists - physicists	6
b) opportunity advise the results to colleagues - experts	1
c) the great international experience	1
d) the development of individuality	1
e) no answer	1

E. What do you regard as most important for you from your attendance at YPT or IYPT?

a) watching of competitors performances, expertise and philosophy	4
b) insight to the mechanism of the tournament	1
c) friendly atmosphere	1
d) chance transfer the idea of tournament to your native town	1
e) no answer	3

F. What do you recommend for future development of YPT and/or IYPT?

a) only English	3
b) enrich - more countries	2
c) all jury must know English	1
d) exact definition of problems	1
e) no answer	3

G. What do you think as not very successful at YPT or IYPT?

a) the ensuring of higher quality of the students presentation 2
b) timing 2
c) the tournament is a few wide-spreat (in the countries even at schools) 1
d) too great contest and grave, too little friendly atmosphere 1
e) some members do not understand English 1
f) no answer 3

H. What do you think about the role of a physics teacher in searching for and developing talented students in physics at school?

a) the conversion of physics to reality, enthusiasm, motivation 5
b) guide in the labyrinth 1
c) he must be all 1
d) find literature, come with ideas, but not with solutions 1
e) singularity of teacher 1
f) no answer 1

I. What, in your opinion, should be emphasised in working with talented students in physics studies at school?

a) perseverance - trial & error; finally - trial & great success 1
b) development of physics knowledgement all the time 1
c) presentation of own work 1
d) motivate them to problem solution of physics for the society 1
e) contacts with other institutions 1
f) creativity and working on real problems 1
g) some emphasis on qualitative physics, order of magnitude estimates, physical insight into the mathematics 1
h) no answer 3

Evaluations of Results

Kluiber, Z., RNDr., PhD., Hoffmann, O., M.Sc.

Team leaders

All the team leaders answered the questionnaires. The Young Physicists' Tournament (YPT) has become the acknowledged national competition in the most countries (73 %). It is obvious that only some schools among all participating countries are able to prepare well their team for the competition.

When taking part in the YPT the team members' progress both in the physics and in their language knowledge. They get acquainted with the system of teamwork. Their thinking about physics and their communication abilities have developed. They gain the stimulation for the next education development.

The competition cost represent a the presence the amount about 500 $ per year. The time burden of the physics teacher - the team leader - is about 400 hours per year.

Besides the YPT, the Physical Olympiad and various forms of physical activities with the common denominator *(characteristic):* conference has become very popular.

The search for and the development of the talents in school are based on the individual attitude to the students, on the quality of physics tuition. In this sense, the role of the tutor is unique. The state organs support the YPT in the significant manner, connected namely to the financial grants.

The articles dealing with the YPT were published, there exist also booklets in which the attention is paid to the information transfer about these competitions, for example booklet by Kluiber, Z. at al: The Development of Talents in Physics, The Union of Czech Mathematicians and Physicists-Prometheus, Prague, 1995, which is known internationally.

In the answers, also some recommendations were present, regarding the number of competition teams, which would correspond to the IYPT rules.

N.B.: Both the questionnaire and the 10th IYPT organisation have been positively accepted by the team leaders.

Students

72 students, i.e. 96 %, have answered the questionnaire. More than 70 % of the students represented the age category 16 - 17 years! 74 % of the students were representatives of mathematics and physics specialised classes. It is obvious that the IYPT participants have been from schools where the YPT has the long-time tradition. 13 % of the students had the opportunity to participate the YPT at the national level for the third time, while 19 % of them for the second time.

The dominant personality, i.e. the leaders of the student teams, is their physics teacher. 47 % of the former YPT participants advise their successors. The YPT has been understood as the national competition - 79 % of the students were the republic final winners.

The winning team members find their role in the team namely as: the theoretical physicist - 34 %, the experimental physicist - 30 %, mathematician - 20 %, the linguist - 14 %.

The preparation for the participation in the competition takes place under the leadership of specialised workplace experts mainly at school, sometimes at these workplaces.

The team training lasts in average 2 weeks and it takes place usually before the final of the YPT.

To improve content of the competition and its organisation the students recommended: to use only the English as the official language, to make the rules more exact, to ensure the more qualified assessing commission.

The students' evaluation of the 10th IYPT tasks:

the simplest -	numbers 16, 17, 12,
the most difficult -	numbers 4, 6, 13,
the most interesting -	numbers 2, 4, 5,
not suitable -	numbers 1, 17, 15, 5.

14 % of the students have used the task solutions for further purposes, e.g. on the conferences or out frame of any competition.

The Physics Olympiad, various conferences and reviews are another most broadened competitions in the countries participating at the 10th IYPT.

The YPT participants take part also in another competition in physics, chemistry or biology with success. Besides the physics, their main interest is concentrated on the subjects as informatics, mathematics, languages and sports.

85 % of students intend to continue in the study at the university, 8 % on technical universities. The studying subjects are assumed to be: physics in 45 %, mathematics in 30 %, biology and chemistry in 10 % of students.

Observers

The observers - the outstanding experts who had the opportunity to follow the performance of competitors, their level of knowledge and organisation of competition have emphasised namely the following acknowledgements:

- the YPT enables the students to get acquainted with the physicist work in more details,
- the recommendation of the use only of the English language and the broadening of number of the participating countries in the future,
- the ensuring of higher quality of the students presentation by the means of better prepared physical duels documents,

- it is obvious that the role of teachers in the process of the talents finding and progressing in physics is namely the motivation of students, in the stimulation of their interest and enthusiasm for physics, in bringing near the whole physics to the students,
- in schools the emphasis should be given namely on the experimental physics, on the presentation of students own work, on the development of creative students abilities, on the mathematical point of view of the physics studies, on the students, respectively school, contacts with the physicists and with the physical institutions.

Research Conclusions

The International YPT has been in general evaluated very positively. The YPT belongs to the most difficult physical competitions for the secondary schools students.

The extremely positive in the IYPT is the application of the physicist work simulation, the language and communicative abilities development of its participants.

The international level of the competition should be substantially broadened, its rules and the organisation of the international final round should be thus further improved.

Indices

Prominents

Prof. Dr. Klaus von Klitzing, Germany, Nobel prize winner of physics for the year 1985

Prof. Dr. Herwig Schopper, Germany, long year CERN director, DESY and chair of The European Association of Physics

Prof. Dr. Gunar Tibell, Sweden, delegate of The European Association of Physics, chair of The European Forum for Education

Dr. Jevgenij N. Junosov, Russia, vicepresident The International Committee for the Young Physicists' Tournament

Observers

Germany: Wolfgang Bürger, Brunhilde Juraschek, Klaus Juraschek, Salvatore Manmana

Singapore: Willie Yong, Joe Martinez

Sweden: Per Åberg, Karin Tilgus

Czech Republic: Štefan Zajac, Petr Kužel

Team leaders

Belarus: Leonid Markovich

Czech Republic: Zdeněk Kluiber, Petr Pavlíček & Jana Neničková

Georgia: George Laskhishvili

Germany: Rudolf Lehn

Hungary: Zsuzsanna Rajkòvits

Poland: Ursula Wožnikowska

Russia: Tatjana Bambourova, Sergey Denisov, Zoya Savilova

Slovakia: Anna Šutáková

Sweden: Sven Ljungfelt

Ukraine: Olexandr Helokinskyy, Valery Koleboshin & Paul Victor

Uzbekistan: Elena Skvorcova

Winners of 10th IYPT

1st place:	**Czech Republic,** Prague **Hungary**
2nd place:	**Belarus**
3rd place:	**Ukraine,** Odesa **Georgia** **Poland** **Ukraine,** Lvov **Russia,** Jekaterinburg **Russia,** Moscow
4th place:	**Germany** **Slovakia** **Russia,** Ural **Uzbekistan** **Sweden** **Czech Republic,** Opava

Absolute Winner:	**Janos Asboth,** Hungary
Winner:	**Adam Glogowski,** Poland
Honorable Mention:	**Libor Inovecký,** Czech Republic **Denis Murakhovskiy,** Ukraine **Yaroslav Lutsyshyn,** Ukraine

A detailed report on the 10th IYPT has been also sent to Mrs. Jaroslava Moserová, vice-chairwoman of Senate of the Parliament, Czech Republic. Her answer is on the next page. The translation of this letter is as follows:

Parliament of the Czech Republic
Senate
Jaroslava Moserová
Vice-chairwoman of Senate

Prague, 25 November, 1997

Dear Mr. Kluiber,

Thank you for your report on the 10th IYPT. Allow me, at the same time, to congratulate you on the successful implementation of this important scientific and educational event.

Yours sincerely,

J. Moserová

To: Mr. Zdeněk Kluiber
Gymnasium
Zborovská 45
Praha

PARLAMENT ČESKÉ REPUBLIKY

SENÁT

JAROSLAVA MOSEROVÁ

MÍSTOPŘEDSEDKYNĚ SENÁTU

V Praze dne 25. 11. 1997

Vážený pane doktore,

děkuji Vám za zprávu o 10. mezinárodním Turnaji mladých fyziků, kterou jste mi poskytl. Dovolte mi, abych Vám zároveň poblahopřála k úspěšnému průběhu této významné vědecké a vzdělávací akce.

S přátelským pozdravem

Vážený pan
RNDr. Zdeněk K l u i b e r

Gymnázium
Zborovská 45
P r a h a

Supplement:

Problems of the 10th IYPT

1. Invent it yourself

   Construct and demonstrate a device which moves in a direction under chaotic influence.

2. Coin

   From what height must a coin with heads up be dropped, so that the probability of landing with heads or tails up is equal?

3. Paper

   How does the tensile strength of paper depend on its humidity?

4. Electron Beam

   An electron beam is cast upon a planparallel plate of known homogeneous. Some of the electrons get trough it, some do not. Try to simulate processes taking place, e.g. using the Monte Carlo method and compare your results with the ones described in literature.

5. Blue Blood

   Human blood is known to be red, but the veins seem to be blue. Explain this phenomenon and illustrate it by a model.

6. Magic Tube

   A Compressor blows air into Ranque-Hilsch T-shaped tube at a pressure of 0,5 Mpa or higher so that the air begins to circulate. In such a case hot air is coming out from one end of the tube and cold air from the opposite one. Find out which end of the tube is the „hot" one and explain the difference of the temperatures obtained. Investigate the parameters this difference depends on.

7. Water Jet

   A water jet streaming vertically downwards from a tube is divided into drops at some distance from the tube. Choose the conditions under which the length of the unseparated jet is largest. What maximum length did you obtain?

8. Flotation

   A piece of chocolate, which is dropped into a glass of soda water, periodically sinks and goes back to the surface. Investigate the dependence of the period of these oscillations which depends on various parameters.

9. Jet-Spread

   A water jet falling onto a horizontal plane spreads out radially. At some distance from the centre the thickness of the layer increases dramatically. Explain the phenomenon.

10. Cooling the Earth

How would the temperature of the Earth change with time, if the Sun suddenly stopped radiating.

11. Candle Generator

Construct a device for charging an electric capacitor (1000 μF / 100 V) using the energy of a candle burning for a period of one minute.

12. Static Friction

A force of motion friction is known to be independent on the rubbing surface area of a body. How does the static friction depend on the rubbing surface area?

13. Tea Cup

If one fills a cup with hot tea (60° - 80° C), a thin layer of steam emerges above the surface. One can see that some parts of the steam layer disappear suddenly and reappear after a few seconds. Investigate and explain this phenomenon.

14. Rain

On a long-time exposure photograph of night rain taken in the light of a projector, the tracks of drops appear interrupted. Explain this phenomenon.

15. Cell and Accumulator

How does the voltage-current characteristic of an accumulator change during discharging?

16. Roghe Spiral

The Roghe spiral is a device where a source of current is connected to a vertically suspended spring, the lower end of which is dipped mercury. Mercury is a highly dangerous chemical substance and thus experiments with it are not permitted. Substitute the mercury with a less dangerous substance and investigate the functioning of this device.

17. Leap

To make a leap it is necessary to squat. How does the height of a leap depend on the depth of the squat?