Sources of motivation of high school students for participation in physics competitions

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Abstract. This article studies motives on why high school students participate in physics competitions in the form of a case study (with qualitative and quantitative elements) focused on one contest. We bring a brief insight into primary motivations for their participation and how it is changing later. The pinpoint of our study is that it is hard to address new participants these days. Their most often motivation for starting in the competition is to get better in physics, general interest in physics and interest in solving challenging tasks. For those who continue in participation – they usually want to get even better in physics. That’s because participants often realise that they are not as good as they thought. A motivation which is getting stronger is also to get an invitation to an educational camp. We also briefly discuss possible demotivational factors.

1. Introduction
This study tries to determine the key factors which motivate (or demotivate) high school students (ISCED 3) for participation in physics competitions. This summary shows a glimpse inside these motivations. The focus is on contests which run entire school year, namely correspondence competitions, and we focus mostly on one of them. Therefore, the results cannot be easily generalised. But they can be at least inspirational for other similar competitions.

Design of this study can be described as mixed since it is a combination of qualitative and quantitative parts. These findings arise from author’s both long experience as an organizer and former participant of some of those activities. That is the reason why we can consider this also as action research. During those years, the author has led many conversations, discussions with many participants of such activities and their organizers (who are usually also their former participants) and several questionnaires. Some of what was a part of the thesis of Kolář (2014) which was concerned by deep reflection and development of the Physics Correspondence Competition (FYKOS). There was also a new internet questionnaire administered among participants of the last six years of FYKOS and its organizers. The percentages of answers showed below are mostly from the mentioned questionnaire.

We addressed 632 possible respondents (FYKOS participants and organizers), and 191 of them filled the form (30 % responsivity). Out of those 191 were 186 participants (53 present and 130 formers) and 45 organisers (21 present and 24 formers). They were 129 men and 61 women.

There are very few public studies focused on similar topics, but such information we try to get can be beneficial for organizers. Something more about feedback for FYKOS is (at this moment only in Czech) at web page http://fykos.cz/zpetna-vazba

1 The sum of percentages is more than 100 %, because participants usually mention more sources/motivations. One participant did not fill his/her gender.
FYKOS is a correspondence competition for high school students (ISCED 3), and it is free of charge. Participants solve physics problems individually and send them to organizers back for correction. Participants then receive feedback and points. The best of them are invited to camps. Similar competition but for younger students (ISCED 2) is Výfuk (~ Calculation of physics tasks). Both are organized and financed by Faculty of Mathematics and Physics, Charles University. FYKOS’ problem assignments can be found at https://fykos.org/problems/archive

2. Sources of information about activity
In the beginning, there must be some information about the activity students can participate. Without knowledge about the possibility of participation, they cannot engage.

Many students mix answers to questions „Where have you heard about competition XY” and „Why have you decided to participate in XY”. On the one side, it can hide the real reason why they chose to participate. On the other hand, the information source can also be motivation for someone to take part. Therefore, it can be tightly bound with primary motivation factors, and we bring this topic, although it can be considered more a marketing topic than educational-scientific.

Data presented in table 1 are from registration forms of seminars FYKOS and Výfuk for last five years (2013 – 2017; N = 920). This data is a better source than questionnaire (mentioned above and used for other parts of this article) because each participant must fill it to send online registration form, but there is only this one sole question about info-source, not any about motivation.

| %  | Participant’s answers                                                                                                                                 |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 40%| A letter from the Faculty that paper and e-mail correspondence to many high school and upper secondary school students and their teachers. We can briefly mention that because of some financial and organizational reasons was the paper correspondence almost abolished. That already caused a relatively high decrease in the number of participants. They received some recommendation from their school or teacher. It is also probable that the letter from Faculty helped them to remember the activity or the letter’s contents was displayed on the school’s noticeboard. |
| 21%| They received some recommendation from another person than a teacher. Those people vary a lot. It can be a friend, a parent, a sibling, a grandparent or rarely even some public person who mentioned the competition. |
| 12%| The internet, links on other web pages or leaflets distributed by other means than by post.                                                                 |
| 8% | Some activities of seminars FYKOS or Výfuk – many of the former participants of Výfuk continue later with participation in FYKOS. Information get through some action organized by the Faculty other than FYKOS or Výfuk - e.g. Open days, other correspondence seminars (Faculty has six correspondence seminars in total now). |
| 4% | Information get through various other activities organized by another body than our Faculty - e.g. Physics Olympiad. |

3. Primary motivational factors
According to many respondents, the motivation often shifts during participation. It is because they usually realize that they like activities organized by correspondence seminar like camps and they take part in it. Since we knew that there is a possibility of changing motivation, we decided to ask separately on the primary motivation (“Why have/had you started to participate in the competition?”) and later =

2 Sum is not 100 % because some respondents mentioned more kind of motivation.
secondary motivation (if they participated for a longer period “Why have/had you continued in participation in the competition?”).

The motivation of people can be complicated and vary. Many people mention more than one motivating factor, but it is almost sure that many of them do not say all the factors, but when we look at individual testimonies we can make ourselves a picture. List of most common factors is in table 2.

Table 2. Primary motivational factors

| %  | Participant’s answers |
|----|-----------------------|
| 18% | They were interested in physics or liked physics. |
| 17% | They wanted to get better in physics, learn something new, improve themselves. |
| 17% | They were interested in solving such exciting problems/tasks. These problems are more challenging, more complicated and more interesting than usual school-book problems. |
| 13% | They have participated in seminar Výfuk before (for students of ISCED 2), and it seemed natural to them to continue in FYKOS (for ISCED 3). |
| 11% | They wanted to get the invitation to the next camp – because they wanted to improve themselves, meet their friends or just heard that camps are great. Even the letter from Faculty itself was motivational for some of the participants. There was written a short text about why it is a good idea to start solving problems – they were motivated probably thanks to that. |
| 11% | They got a recommendation from a friend or wanted to meet someone again. It is quite common that a student is a participant in more correspondence seminars. |
| 10% | They were challenged by complex and hard tasks. |
| 8%  | Competitiveness – they wanted to be better than the others. They wanted to win. |
| 6%  | They “just wanted to try it”. |
| 5%  | They were motivated by their teacher. |
| 5%  | Physics Olympiad and its activities. |
| 5%  | The seminar seemed attractive to them. |
| 4%  | The solving of some seminar is fun. |
| 5%  | Recommendation from a schoolmate. (We decided to differentiate recommendation from a schoolmate or another friend. We can see that there is more often some recommendation from someone not from the same class.) |

There are also some reasons that were mentioned by only some participants but are interesting. We quote some of them

- The mention a concrete organizer who convinced them.
- Because they were bored/had too much free time
- Someone wanted to have similar hobbies as his/hers (future) partner.
- Someone wanted to find a partner.
- They received a recommendation from parents or siblings.
- They wanted to know better the school/faculty they planned to study.
- Some of them live in Jihomoravský kraj, where they can receive a stipend for participation in educational activities.
- Some of them earn some “points” at their school.
- Etc.

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3 We would like teachers to be more motivational factors for participants. But clearly they are neither the most common informational source nor strongest motivational factor.
Only several people do it for prizes (other than the camps) - although they receive some books and other rewards, they can also acquire the certificate of the successful participant if they gain at least 50% of maximum points. That document can be used as an alternative to entrance examination to the Faculty of Mathematics and Physics.

4. Decision for participation
When students know about some competition, and they are motivated enough, they can get to the decision for participation. That is the critical moment. Almost all this research is biased because we almost don’t know why the others never started to participate. Although some of them knew about the competition and they were interested in physics they had never sent a single solution.

Although the initial decision for participation is formed, it is questionable whether they continue during the school year. On average, only 31% participants of FYKOS send the last (sixth) series of the school year (the average is for all the 30 years of FYKOS).

5. Secondary motivational factors
As it was mentioned, the motivation often shifts, but it is not the same for each participant. Some of them were decided to participate because they had heard about camps, and they continue for the same reason. Some of them are interested in physics and challenging problems and never go for any face-to-face activity like camp. But in general, the motives are similar like before and they are listed in table 3.

| %    | Participant’s answers                                                                 |
|------|---------------------------------------------------------------------------------------|
| 34%  | They wanted to further **improve in physics**. Participants often realize that they are not so good at physics when they face the advanced physics on camps or in the complex problems. |
| 31%  | They wanted to **participate** in the **camp again**.                                   |
| 20%  | They mention that the participation in the **camp was a great experience**.             |
| 18%  | They liked such challenging problems.                                                   |
| 16%  | They **wanted to participate** in general.                                              |
| 13%  | They were **interested in physics**.                                                    |
| 8%   | They tried to **meet** their **friends** again.                                         |
| 8%   | They liked to **compete** with others and trying to be better than them.                |
| 3%   | They wanted to **prepare for their future studies**.                                    |
| 3%   | They prepared themselves for **Physics Olympiad**.                                      |
| 3%   | They had enough time, and it was a way **not to be bored**.                             |

There also were some others but mentioned only a few times.

6. “Demotivational” factors
It is usually harder to obtain information from former participants why have they ended. But it can be even more interesting for those organizing such competition whether they can improve some mechanisms etc. Some of those who already finished their participation and even some of them prematurely (not in the last year of high school) but also filled the questionnaire and we can bring some insights of it.
Many participants from those willing to answer questions finished their participation by the end of high school (after final exam = maturita) – 95% from organizers respondents.

Maturita exam – sometimes they ended involvement before the final year of high school to have time for preparation for the maturita exam, sometimes they finished during the last year of study.

Lack of time in general: They had too many other activities so decided to end. Solving of the seminar took too much time.

They have realized that they cannot participate in the camp – sometimes the date of the camp is public a long time ago and it may collide with

They were too lazy to continue.

The problems were too hard, or they thought that they are not good enough to solve such tasks.

They have changed their primary field of interest (e.g. for informatics, mathematics, biology, medicine)

Someone did not like texts in the Slovak language. Some solutions which are written by Slovaks are not translated into Czech. That is because the Czech language is quite similar although they are different languages.

There are also some other demotivational problems which prevent students from participation in the first place. But it is hard to address it. We know some indices from organizers who never participated or from friends of organizers. It can be held as even more biased than the rest of the research, but we can mention at least some remarks without any estimates.

They were lazy. But this can be just a quick, simple answer and not deep enough.

Someone would have participated if the prizes for the best students were much higher. Usually, winners get some books or board games. But it seems that they are not the primary motivation for participation in general. But even valuable rewards do not guarantee high increase interest of students – and it is especially financially problematic to increase the budget for prizes.

They did not know that camps are high-quality. They thought that the participants of competitions must be some crazy people. They were afraid of participation in camps. For such reason, some of them never started to participate.

They have not received any impulse – like a recommendation from a teacher or a friend.

7. Final remarks

The motivations behind participation in physics contests are a fascinating topic. We brought a narrow view to one kind of competition which can also be geographically or culturally specific. It would be interesting to study this issue in other activities and other countries.

8. Acknowledgements

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