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Computer Science Contests in Germany

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Abstract. In Germany, the preconditions for running a successful Computer Science contest for secondary school students are not perfect. However, many contests that are related to the area of Computer Science are run by as many different organizations. The Federal Contest in Computer Science (German: Bundeswettbewerb Informatik, short: BWINF), a task-based contest with two homework rounds and a symposium-style final round, is the most important, nation-wide contest in the field. BWINF office is also responsible for Germany's IOI team selection and participation. In addition, in recent years the office has been running several other projects to popularize Computer Science and promote talents in this field.

Key words: computer science contests, tasks, grading, teacing informatics.

1. Introduction

1.1. *Preconditions for Contests*

There are three important observations to be made when looking at the preconditions for running contests for (secondary) school students. First and foremost, the responsibility for the school system is not held by the federal government, but by the governments of the 16 federal states. Some basic properties of the school system hold nation-wide, but especially in the details and for non-standard subjects like Informatics, the situation may vary significantly between the states. Many educational initiatives are run in a single state only, and there are many state-wide student contests, often in parallel and sometimes even in conflict with nation-wide contest activities. Recently, the German constitution was changed to make sure that the state governments have full responsibility for school education. The federal government was left with some influence on academic education and was allowed to continue its activities in the area of promotion of the gifted. Hence, the federally supported nation-wide contests can be continued.

Second, during several decades many teachers and schools in Germany focussed on leveling education to the intellectual capabilities of the majority of students. At the same time, promotion of the gifted almost was a non-issue. Only in recent years, this situation has improved. In addition, many schools are striving to develop and demonstrate their special profile. This has led to an increased popularity of contests accessible to many students, like the "Math Kangaroo". However, these contests do not naturally lead to participation in more advanced contests like national olympiads.

Third, the lack of a centralized contest organization led to the birth of a huge variety of contests, many of which are organized by non-governmental institutions or industry companies. In such an environment, it is often difficult for teachers to recommend good contests. Teachers complain about a "contest flood" they can no longer cope with. Many company contests are organized only as a public relations activity, but typically this is well hidden. In addition, contests with government funding cannot compete with the awards and prizes that contests with funding from companies or private institutions can offer.

In summary, participation in a nation-wide, government-funded contest are in no way a standard activity for German school students. Therefore, only very few contests see really high participation rates.

1.2. *Informatics at School*

The subject of Informatics is an optional subject in most federal states. Exceptions are seen in three of the 16 states only. Informatics is mainly taught in the final years of Grammar School, but nevertheless it can be difficult to choose Informatics as a subject that will become part of the final school exam "Abitur". Due to the low importance of Informatics, there are only few teachers with a genuine education in Informatics; most Informatics teachers have a supplementary education in Informatics. This situation given, it is no surprise that Informatics is not one of the popular subjects at school. Among girls, it is even one of the least popular subjects at all.

1.3. *Contests in Computer Science*

In the next section, we will describe "Bundeswettbewerb Informatik" (short: BWINF; Engl.: Federal Contest in Computer Science; see also BWI), a nation-wide contest, run by the German Informatics Society together with the Fraunhofer association of information and communication technology research institutes. It is mainly funded by the federal government and hence the "official" German contest in the field. However, it is by far not the only contest for German secondary school students related to Computer Science: There are multi-media contests, software project contests run by industry or non-profit institutions, and several robot construction and programming contests (like Robocup Junior). However, BWINF is probably the contest with the highest reputation; BWINF winners receive a university scholarship from a national foundation. The contest next important to BWINF is the combined Mathematics/Computer Science section of "Jugend forscht" (Young Scientists). In this competition, participants present their own inventions or research projects. For a more detailed overview (in German) about related contests, see (Pohl, 2005).

2. Bundeswettbewerb Informatik

In 1980, Informatics was not yet established as a school subject. This gap was to be filled with a nation-wide contest. Its first issue was called "Youth Programming Contest";

the winner[1] was celebrated at an IFIP congress in Lausanne in 1989. In terms of Pohl (2006), the contest began as project contest; participants were asked to describe their own programming projects. The third contest was the first one to be called "Bundeswettbewerb Informatik", and from the fourth contest, the contest model was changed to the one that is still being applied today.

2.1. *BWINF Procedure*

There is an office consisting of a full-time manager (that's me) and a half-time secretary, paid to run the contest, organize and execute IOI (and CEOI) training and participation. The resources of the office are pretty much consumed by organizational, administrative and public relation work – since it is not standard for German students to participate in contests, each contest needs advertising, given the situation that there is such a huge quantity of contests and competitions. Furthermore, there is a volunteer committee for task creation and selection, and a steering committee with representatives from the organizing institutions as well as the federal and state ministries. In the first two rounds, the jury is composed of students (some of them former contestants), who are paid a small fee. In the final round, committee members and experts from both school and academia are called into the jury.

The contest is organized in three rounds. Contest task sheets and posters are sent to all secondary schools, and the BWINF office also tries to announce the contest in the media. Students register by sending their solutions. They work at home, individually or in (preferably small) teams. In general, five tasks are given, and if three of them are solved, the students qualify for the second round. In this round, students still work at home, but must solve the problems on their own. The best of the second round (ca. 30 people) are invited to take part in the final round, which is organized as a meeting. The participants of this final round are interviewed individually by jury members, and, on two days, need to work in a group on one problem each day. Mainly because it is a homework contest, it is run during a whole year; often, the new contest starts before the final round of the running contest has been completed.

2.2. *Characterizing BWINF*

First, it is most easy to say what BWINF is *not*: In contrast to the International Olympiad in Informatics, its regional variations like CEOI, Baltic OI, etc., and many national olympiads (confer Pohl, 2004), it is not a contest with programming exams and a thematical focus an algorithmics. and to a task contest with long-time homework rounds, manual jury grading and submission of both executable programs and written solution descriptions. Following the categories that were suggested by Pohl (2006a) to describe contests in the area of Computer Science, it has the following properties:

Scientific Area As a contest for secondary school students, BWINF needs to cater for the possible Computer Science expertise of those students. As already mentioned,

[1] The first winner, Otfried Schwarzkopf, now is professor for theoretical Computer Science in Korea.

Informatics is not an obligatory subject in German schools and not very popular as well, there is no standard level of expertise that can be required. As we know, many contestants are self-taught only, while the students of a few specialized schools learn about Informatics on a high level already. Therefore, the contest needs to set its own standards, but at the same time should consider the most important topics of school Informatics. As a consequence, BWINF has basic algorithms as its core area, but also deals with information modeling, data bases, simulation processes, language and text processing, and other areas of Computer Science.

Style BWINF is a task contest; in all rounds, tasks are given.

Duration In the first two rounds, contestants have about two and four months, resp., to work on the tasks. In the first round, five to six tasks are given, and solutions to at least three need to be submitted in order to qualify for the second round. In the second round, three tasks are given, two of which the contestants need to select and work on. The third round, the final, is different: On each of two days, contestants work in groups of four for about four hours on one single task. In addition, each individual contestant has two interviews, each with one jury member.

Grading In all rounds, there is manual grading by jury members. In the first two rounds, jury members follow given grading schemes. For each task, there is a grading scheme that defines a set of crucial issues. For each such issue, its weight and influence on the grading are prescribed. In the final round, jury members need not follow a grading scheme. They translate their assessment of the contestants' performance into a numerical score. In the jury meeting however, where winners are chosen, there is still time for discussions about individual contestants; the addition of scores is regarded as the foundation for the final decisions only.

Submission In the first two rounds, contestants submit written descriptions of their solutions. In the task sheets, a certain structure is recommended for these descriptions: abstract solution ideas first, then a documentation of the most important source code components, followed by examples that demonstrate the program's abilities. Also, source code at least of the main parts of the solution program (no IDE-generated code, no GUI code) needs to be submitted in print. This is to ensure that grading can be performed without executing the solution programs; resource constraints of the grading process do not allow for a genuine testing process. In the task sheets, it is explicitly mentioned that grading may rely on the written material only. The final round, again, is different: Contestants are graded individually based on how they perform during interviews and group work; groups give presentations of their results, but also in an overall weaker group, a single member may have made excellent contributions.

Divisions BWINF is not structured into divisions. In each round, there is only one task set for all contestants. However, there is a slight exception to that rule: In the first round, one task is identified as "junior task"; this task is supposed to be somewhat easier than the others and aims at attracting younger students to the contest. Therefore, it must not be chosen by contestants who are more than 16 years old.

2.3. *25 BWINF Contests – Observations Made*

In 2006, the 25th Bundeswettbewerb Informatik was started. On the occasion of this anniversary, a report about the development of the contest was published (Pohl, 2006b). Several central observations were stated:

- the average participant is a male student in grade 12 of a grammar school;
- female participation is very low, but has slightly increased (!) in recent years to about 5 percent (see Fig. 1);
- while in the early years of the contest, BWINF typically had between 1000 and 2000 participants per year, there is now a fairly stable annual participation rate of about 700 students (see Fig. 2);
- in some federal states, especially from the Eastern part of Germany, participation is

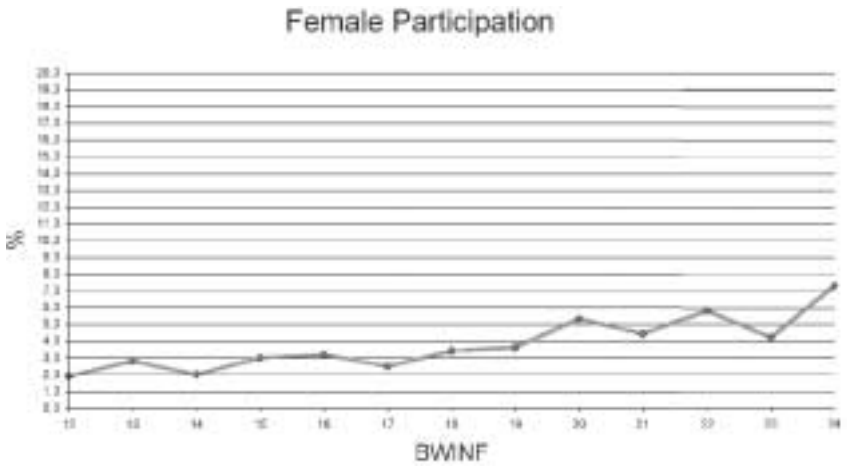

Fig. 1. Female participation rate from 12th to 24th BWINF.

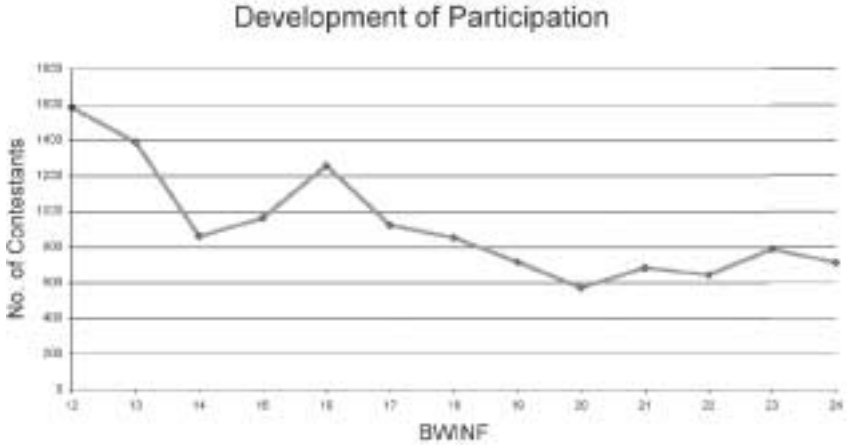

Fig. 2. Number of participants in the first contest round from 12th to 24th BWINF.

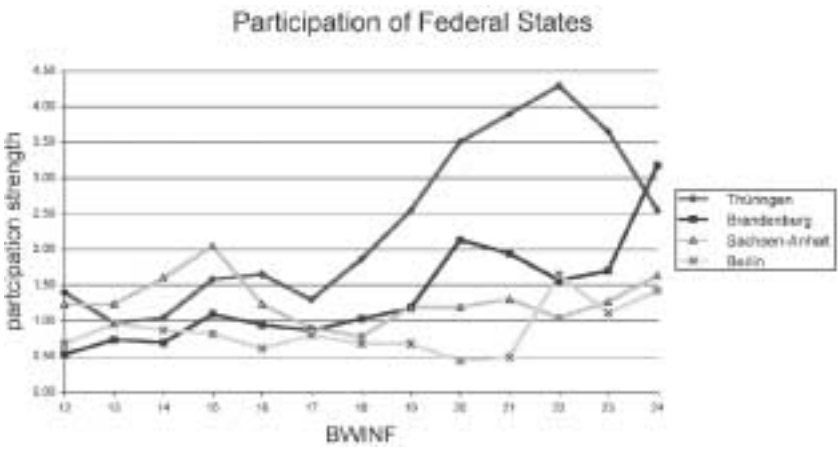

Fig. 3. Federal states with strong participation in BWINF.

very strong, but in the states with large population, participation is relatively weak. This assessment is based on the relation between the state's share in BWINF participants and its share in the overall number of grammar school students in Germany. For instance, a state with a 10 percent share in BWINF participants and a 5 percent share in high school students has a participation strength of 2. Fig. 3 shows the development of participation strength values (from 12th to 24th BWINF) of the states with the highest such values of recent years. Note the significant changes in recent years.

3. IOI Qualification

The BWINF office also is responsible for selecting the German team to participate at the International Olympiad in Informatics (IOI). In addition, German participation at CEOI is supported by the federal government. Since 2001, there has been a delegation at Baltic OIs, too, but Baltic OI participation and (for the first time in 2007) organization must be funded by non-government sponsors.

About a dozen IOI candidates are selected from the final round of BWINF based on if they satisfy IOI age requirements. Some other candidates are selected from the "Jugend forscht" contest mentioned at the beginning. Since both contests are very different from IOI-style contests, three training camps are organized to introduce the candidates to IOI-style problem solving. The training, including the tasks for training exams, are prepared by the BWINF office. Moreover, many former German IOI participants contribute significantly to our IOI training, as well as to organizing olympiads like CEOI and BOI in Germany.

Note that the whole selection process takes place in the year after the final round of BWINF. So, German students go to IOI one year after finishing the national contest and even two years after entering it. As a consequence, many German IOI contestants can

participate in IOI only once. In recent years, we have seen a higher number of young contestants in the BWINF final round, and therefore have had a few more two- and even three-year participations in IOI. Since the national contest activities do not give experience in IOI-style contests, OI-experience is a very important factor for IOI-success of German contestants. In addition, the achievements of German IOI participants are very much dependent on their personal ambition. After two years of first national contest and second IOI training, IOI contestants tend to regard their qualifying for the IOI team as main achievement; international comparison is of lesser importance. In such cases, delegation leaders and coaches have difficulties to keep the motivation high.

At IOI, Germany typically sees a good overall team performance, with medals for all or almost all team members. Gold medals, however, are rare; in 18 IOIs, 8 gold medals were won by 8 German contestants.

4. Further Activities

For many years, the BWINF office has been suggesting to extend its activities in popularizing Computer Science among young people and promoting talents in that area. With many German students lacking a solid education in Computer Science, non-school education offers are needed. In 2006, proclaimed as "Year of Computer Science" by the German Federal Minister of Education and Research, the BWINF office was granted the needed resources to run the project "Einstieg Informatik" (First Steps into Computer Science, see (Pohl *et al.*, 2006)), to develop and apply approaches both to teach ideas of Computer Science to children and to provide interested youngsters with information about how to learn more about the subject. The project can be regarded as success: Within 10 months, the project web site attracted about 110.000 visitors. The project gave presentations and shows at public events with an overall number of more than 600.000 visitors, and addressed teachers at conferences with an overall number of about 2000 participants.

Using the resources of the "Einstieg Informatik" project, the first German participation in the International Beaver Contest (Dagiene, 2006) took place in December 2006. Although the resources were not sufficient advertising the contest in the large, more than 2100 students participated. Table 1 gives more detailed information about the participation, divided by grades and gender. Germany's participation in the Beaver initiative shall

Table 1

Participation in the first German Beaver contest 2006

Grades	**Participants**	**Girls**		**Boys**	
		Number	***Percent***	***Number***	***Percent***
All	2126	698	32.83%	1428	67.17%
5–8	959	394	41.08%	565	58.92%
9 and 10	479	133	27.77%	346	72.23%
11–13	688	171	24.85%	517	75.15%

be continued, while “Einstieg Informatik” was unfortunately discontinued with the end of the “Year of Computer Science”.

5. Conclusion

In spite of the many and diverse contests in the area of Computer Science that students can participate in, universities have seen a strong decrease in the number of students of Computer Science and related subjects. Contests alone are not sufficient to promote a subject and its talents. The BWINF office is currently looking for support of its plans to continue promotional activities like those of “Einstieg Informatik” and set up a virtual community of talents in Computer Science as central entry point for school students who are interested in the subject. Only if such activities are successful, participation in the BWINF contest can be increased again, which in the end might also lead to greater international success of German IOI contestants.

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W. Pohl was educated in computer science, and received a PhD in 1997 from the University of Essen, Germany. For many years, he investigated the use of artificial intelligence techniques for the improvement of interaction between humans and machines. In 1999, he changed position and perspective by becoming executive director of the German Federal Contest in Computer Science. Among his responsibilities is to coach the German IOI team and lead the German IOI delegation. Now his interest lies in improving computer science contests, establishing new ones, and work on diverse other projects, everything in order to popularize computer science among youth. From 2003 to 2006, he was elected member of the IOI International Committee, and briefly held the position of executive director of IOI in 2006.