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Indonesian Olympiad in Informatics

Ilham W. KURNIA
Computer Science Faculty, University of Kaiserslautern, TU Kaiserslautern
Fachbereich Informatik, Gebäude 34, Postfach, 30 49, D-67653 Kaiserslautern
e-mail: ilham@cs.uni-kl.de

Brian MARSHAL
School of Computer Engineering, Nanyang Technological University
Nanyang Avenue, Block N4, Singapore 639798
e-mail: brian.marshal@pmail.ntu.edu.sg

Abstract. This article describes the experience of Indonesian Olympiad in Informatics (abbreviated as OKI in Indonesian) in introducing informatics to young generation in Indonesia through a form of competition. Organizing an informatics olympiad in a large developing country requires dealing with a myriad of challenges, such as unbalanced distribution of infrastructure development and poor human resource. In Indonesia, these challenges are dealt by staging a multi-tiered selection, concentrating on developing online training system and creating a strong cooperation with top universities. We analyze briefly how these efforts impact the spread of participation of OKI.

Key words: informatics, olympiad, training.

1. Introduction

Indonesian Olympiad in Informatics (abbreviated as OKI in Indonesian) is an informatics contest started in 1995 as an initiative from individuals such as Joko Saputro. The main goal of OKI is to introduce young generation in Indonesia to informatics through a form of competition, as the formal curriculum of pre-university education in Indonesia does not include any informatics education. In addition, OKI organizers coordinate the selection and training process of students to take part in IOI.

In the past 15 years, the number of participants of OKI itself has grown from 1 in 1995 to 1495[1] in 2009 with the primary sponsorship of the Ministry of National Education. Indonesia has participated in IOI every year since 1995 (with exception of 2003 due to visa problems) has collected in 2 golds, 11 silvers and 16 bronzes.

Despite the increase in the participant count, it is still relatively difficult to train the participants to reach their maximum potential. In this paper we look into factors that contribute to this difficulty, in particular with regards to poor infrastructure and human resource conditions, and what ways we have taken to resolve it.

[1] 1495 is the number of participants at the provincial selection stage in 2009. The number of participants at municipal selection stage is difficult to estimate since not every municipal keeps track of this properly, and some municipals even have extra selection stages.

This paper is organized as follows. Section 2 documents the challenges that are faced in organizing OKI. Section 3 discusses how they are tackled. In Section 4 we give a brief evaluation of OKI in terms of the participants. We close with our future plan.

2. Challenges

OKI continually faces multifaceted challenges and evolves accordingly. Here we focus on two main dimensions: infrastructure condition of Indonesia and human resource.

2.1. *Infrastructure Condition*

Indonesia is an archipelago of more than 17000 islands, with some 900 islands are inhabited, divided into 33 provinces[2]. It extends more than 5000 kilometers from east to west and more than 1500 kilometers from south to north, such that a hypothetical direct flight from Banda Aceh (west end) to Jayapura (east end) would take around 6 hours. 60% of 213 million citizens live in the Java island (Statistics Indonesia, 2005), where the capital of Indonesia, Jakarta, is, and most infrastructure development is done in this island.

Since 2003, a cooperation of three ministries in Indonesia execute the One School One Computer Laboratory program to "provide computer laboratories in all schools in Indonesia" (Salahuddin, 2005). However, in 2007 from 200000 schools, only a quarter have an unspecified kind of internet access, and in 2009 the ratio of computers to students in public school is 1:3200 (Business Monitor International, 2009). One participant said that he had to walk more than 50 kilometers to get computer access.

From these factors, we find that it is quite costly to gather so many potential students to have proper training. One alternative is to use the internet as a medium for knowledge transfer, but other means are also needed to reach more students.

2.2. *Human Resource*

There are three main factors of the human resource dimension that affect the organization of OKI, namely the secondary school curriculum, the tertiary education related to informatics, and the number of active organizers of OKI.

The official secondary school curriculum in Indonesia does not include informatics, as mentioned in Section 1. Consequently, there is a lack of secondary school teachers having the skills to teach informatics. At the few schools which offer informatics as an extracurricular subject, this subject is taught with an inclination towards using applications, such as word and image processors. The core informatics or even programming teaching is lacking, except in very select few, mostly at schools which have prior strong exposure to OKI. This means that developing the skills of potential students needs to be

[2] A general map of Indonesia with names of the biggest islands is available at `http://en.wikipedia.org/wiki/File:Indonesia_map.png`. A non-annotated map can also be seen in Fig. 2.

done in a more direct way. However, to be more effective in the long run, educating the teachers is a priority as the dependency of teachers by the students at school in Indonesia is relatively high.

Just as the infrastructure development centers in Java, skilled human resource is concentrated also in Java. Only 145 institutes in all other islands, compared to 256 institutes in Java, provide university-level informatics education (Directorate of Higher Education, 2008), and the quality differs significantly compared to the top universities in Java.

One factor that has a significant impact on the operational of OKI is the active organizers. Currently there are less than 10 active individuals in the main OKI organization which consist of university lecturers and OKI alumni. Moreover, they are involved in OKI as part-time (voluntary) organizers, which causes the implementation of many ideas to be brought up slowly. While the number of OKI alumni increases each year, this does not immediately translate in an increase of available human resource on site. A significant portion of the top alumni went to universities abroad (mostly Singapore), and the others who are absorbed in Indonesian universities pursue other interests.

3. Solutions (So Far)

To overcome the aforementioned challenges, we describe several aspects of how OKI is organized. First we describe the structure of the competition itself, followed by the online training aspect and the language used to introduce programming to newcomers. We then explain how the cooperation with top universities is built through the formation of OKI Bureaus. We also sketch other aspects of the organization of OKI.

3.1. *OKI Structure*

OKI is a one-year multi-tiered competition whose stages of the olympiad can be seen in Fig. 1. Each stage prunes down the number of participants to provide more intensive attention to each remaining participant. Since an edition of OKI lasts across two academic years[3], participants who are already in the last grade of schooling are not allowed to enter the pre-training camp selections.

The multi-tiered structure serves a couple of purposes. One purpose is to encourage more participation which increases the exposure of informatics in secondary school. Being a representative of their school/municipal/province may give the needed motivation to participants from less developed areas. Another purpose is to lessen the influence of luck in the selection process, especially towards the IOI team formation.

In the following subsections, we detail the two main parts of the OKI structure: the pre-training camp competition and the training camps.

3.1.1. *Pre-Training Camp Competition*

The first three stages of OKI focus on identifying participants who have the potential to be skillful in informatics. We try to assess this potential by employing two types of

[3]The academic year in Indonesia starts from July and ends in June.

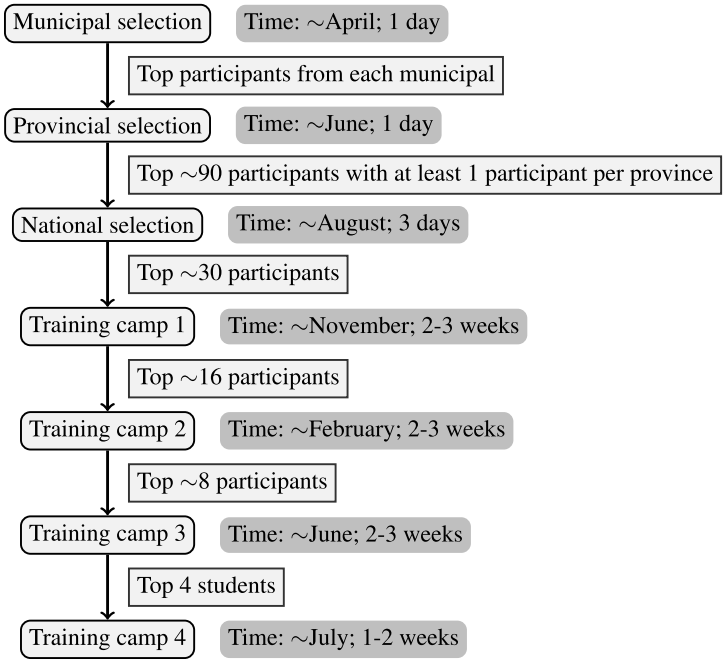

Fig. 1. Stages of OKI.

exams: analytical and algorithmic exams. The analytical exam is similar to the logic category exam used in the Brazilian Olympiad (Anido and Menderico, 2007), with extra arithmetic puzzles. The algorithmic exam consists of fundamental questions of programming techniques, such as control flow, variable assignment, logical operators, loop and recursion, using Pseudopascal (see Section 3.3). Although these two exam types persist, the exam format itself is still evolving.

What differentiates a stage from the other is the difficulty of the exam, the variation of questions and the proportion of aggregate marks between the two exam types. In the municipal and provincial stages, the analytical exam carries the same weight as the algorithmic exam, and both pen-and-paper exams consist of multiple choice questions. The programming exam at provincial stage is harder than at municipal stage.

Unlike all other stages, in the provincial stage, we take at least 1 participant per province to the national stage regardless of his or her result. This main objective of this decision is to give opportunity to all provinces to present their best participants in the national stage.

In the national stage, the analytical and algorithmic exams still exist, but now they have less weight. More emphasis is given to solving programming tasks. To see how far the participants are able to use their analytical skills to solve problems and program, the programming exam consists of a handful of simple implementation tasks (e.g., printing out the triangle number sequence and dealing cards) and harder tasks involving recursion, sorting, and searching.

3.1.2. *Training Camp*

After the national stage, we have a series of training camps. The training camps, which are round-robinly held at OKI Bureaus, are geared towards preparing the students for IOI. In the first two training camps, the participants are given lectures by university lecturers and OKI alumni consisting of material from the IOI syllabus (Verhoeff *et al.*, 2008). After each lecture, participants are given several basic programming tasks related to the lecture. Participants of the third and fourth training camps are drilled with typical IOI problems. The third training camp also serves to finish any parts of the syllabus that are not covered yet in the previous training camps. To rank the participants, scores from the lecture exercises and IOI-like simulations are aggregated with more weight given to the simulations.

Training camps give us opportunities to monitor closely the progress of each participants, especially at later stages, and tailor the direction of the camp to focus on their weak points and build their self-confidence. From our experience the participants get a boost of motivation when they correctly solve a problem. Therefore, we choose problems such that on each day, each participant should be able to solve a problem, while at the same time serving up at least one difficult problem to keep them thinking.

The small number of participants also allow us to experiment with different activities, such as programming on paper, emulating code-breaking session (Burton, 2008), and individual new problem composition and cross-solving them. While these activities spark the enthusiasm of the participants, the most important part of the training camp remains the discussion sessions. We find it crucial for an effective discussion session the presence of a moderator who knows the problems and ideas of the solutions, or at least directions to find the solutions. Thus, the ideal moderator is usually the problem setter.

3.2. *Online Training*

For participants who want to prepare themselves for OKI, we provide online training, which at the moment are opened only before each competition stage to allow intensive supervision. Pre-training camp stage up to the second training camp stage online training centers around topics which are examined on that stage. For the advanced stages, the online training is focused on building the problem solving and coding experience of the participants. To enhance the competitive spirit, the training material is given in levels akin to USACO Training (Kolstad and Piele, 2007), where participants may only move up a level after they finish all the work, and participants can view real-time how the others are faring.

Online training brings a number of benefits. First of all, it allows participants to improve themselves independently and systematically, even without the presence of a teacher. Secondly, the supervision in the form of comments on submitted works, hints, and clarification request replies allows the training to go more dynamically. This, in turn, allows us to recruit OKI alumni who are more interested to contribute this way. This also causes the student-teacher barrier to be much less due to the insignificant age difference.

Being an online training, the participants (and also the supervisors) have the flexibility to administer their own training session between a fairly large time period. This flexibil-

ity gives the participants time to actively participate in school life, which would not be possible if they were to study in a weeks-length training camp. However, as this online training is quite new, we need to optimize its usage and enrich the material.

3.3. *Pseudopascal*

Pascal is a language designed with pedagogical aspects in mind (ISO 7185). This advantage is utilized in OKI as the base language for the algorithmic test. Using pure Pascal language, in the past, have discouraged several potential participants who already know other programming language to take part. Therefore, in OKI we use a subset of Pascal called Pseudopascal (Setiawan, 2006) which includes only the following features:

- standard data types, except sets, pointers and (text) files,
- all Pascal control flow commands, except `goto`,
- all predefined statements and expression constructs remain as in Standard Pascal, except `with`,
- procedures and functions, without directives (`forward`, i.e., without mutual recursion),
- and predefined procedures related to reading from/writing to standard I/O.

Additionally, we can embed natural language into the program to allow some flexibility when describing an algorithm or a task.

In addition to simplifying the language, the participants are still able to program in Pseudopascal (minus the pseudocode) and have it compiled using a Pascal compiler, such as Free Pascal used in IOI. Thus, it integrates well with the online training application, and also previously developed learning material can still be used.

3.4. *OKI Bureaus*

In attempt to bring more manpower on board and spread the load of organizing OKI, we established OKI Bureaus. The bureaus function not only as a possible place to hold training camps and centers of information distribution, but also as regional contact point for arranging local training. For the universities, the training camps are good opportunities to attract potential students by showing directly what facilities they have. In return, they provide the participants with a head start in making their choice for tertiary education.

There are at the moment 5 OKI-bureaus as a result from our cooperation with University of Indonesia, Bandung Institute of Technology, Bogor Agricultural University, Gadjah Mada University, and Sepuluh November Technology University.

3.5. *Other Steps*

Starting from 2002, the Ministry of National Education organizes an annual national science olympiad (OSN in Indonesian) which centralizes the national selection stage of all different science olympiads. We take advantage of OSN to distribute offline materials, such as OKI live CD with grading system and eBooks, for the participants and their

teachers (supply permitting, participants of other olympiads) to bring home and further distribute especially to future participants.

We also hold teacher conferences during OSN to gain feedback about the condition at their places and inform them more about OKI. Additionally, OSN also ranks each province according to the performance of its participants (in terms of medals). This motivates provincial government to provide funds to train potential students. When possible, these seminars are also held at provincial selection when a member of OKI organizers is invited to oversee the selection process. These opportunities, however, are more sporadic than the annual OSN.

4. Results

Table 1 shows that participants from Java and Bali dominate training camps. This domination is being challenged by other regions, with increasing number of participants from Sumatera who pass the national selection. In the past 4 years, participants from Borneo and Sulawesi finally managed to break through. We attribute this growth to the decision of taking at least 1 participant per province for the national training and the online training which becomes more robust in the last few years.

Although the proportion of non-Java/Bali training camp participants shows an increasing trend, it still proves to be quite difficult for those participants to become an IOI team member. As shown in Fig. 2, except 1 participant from North Sumatera, so far only participants from Java and Bali manage to enter the IOI team. The reason for this is the stronger knowledge base and more local programming contests available in Java and Bali.

One pleasing tendency from the data we have is that participants who manage to enter the training camp stage usually bring a positive impact to their schools in terms of the success rate of getting more participants into the training camp. At the very least, participants from the same area become more competitive at national stage. We hope to see this snowball effect continue and create more areas where this effect can begin, especially in the eastern part of Indonesia.

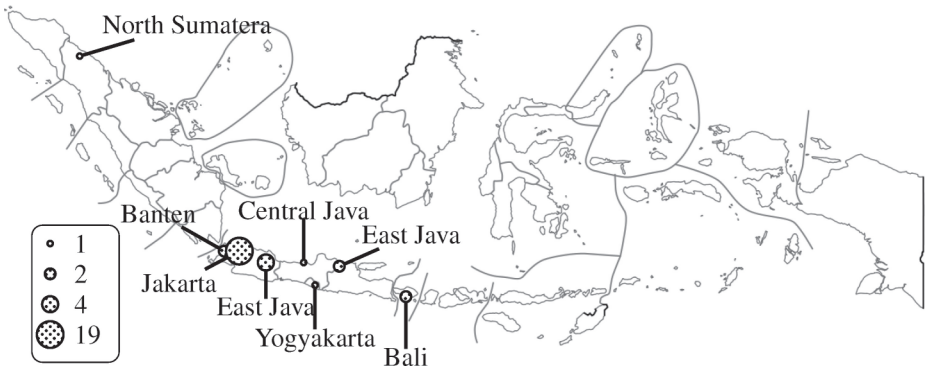

Fig. 2. 2002–2009 IOI team member count aggregation map.

Table 1
Participant province origin at the first training camp leading to IOI 2002–2009

Province	2002	2003	2004	2005	2006	2007	2008	2009	Total
Java									
Jakarta	10	9	4	5	8	8	6	7	57
Central Java	2	3	9	6	3	5	4	3	35
West Java	4	7	4	6	4	3	1	2	32
East Java	2	6	2	4	4	1	1	3	23
Yogyakarta		1	1	4	2	3	3	2	16
Banten		2	1	1	1	1	3		9
Total for Java	18	28	21	26	22	21	18	17	172
Bali	1	3	3	2	2	1	1	1	14
Sumatera									
Jambi			2	2	4	3	2	2	15
Riau	1	1					1	1	4
South Sumatera		1				1		3	5
West Sumatera								1	1
North Sumatera				5	6	1	2	2	16
Total for Sumatera	1	2	2	7	10	4	5	8	41
Borneo									
West Borneo					3	2		2	7
Central Borneo					1				1
Total for Borneo					4	2		2	8
West Nusa Tenggara	1	1	1	1					4
Sulawesi									
North Sulawesi					1				1
South Sulawesi							1		1
Gorontalo								1	1
Total for Sulawesi					1		1	1	3

5. Conclusion and Future Work

We presented the challenges of organizing an informatics olympiad in Indonesia and the implemented solutions which deal with these challenges. While the measure is not there yet to judge the progress so far with respect to the goal of OKI, we see that these solutions produce some improved results in terms of an increase in participants quality from areas without prior history of success in OKI.

Clearly, there is a room for improvement even with limited manpower. In the short-term future, we are concentrating on enriching the online training material, offering online contests and writing more informatics books for both the students and the teachers. We also start to keep track of the alumni to see the impact our alumni have.

Acknowledgment

We would like to acknowledge Suryana Setiawan, the chair of OKI and Indonesian IOI team leader, for his continuous and relentless effort to drive OKI from 1996. Without his involvement, both in the technical part, by making an online judge himself, and organizational part, OKI would not have developed this far. We also would like to thank Ardian K. Poernomo for reviewing previous drafts of this paper.

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I.W. Kurnia is an OKI alumnus and a coach since 2002. He participated in OKI 1999–2002 and IOI 2002. During the years at University of Indonesia studying for his bachelor, he gained hands-on experience in organizing national selections and training camps. He is a Ph.D. student at University of Kaiserslautern working on object-oriented program verification.

B. Marshal is an OKI alumnus, who participated in OKI 2005–2007 and IOI 2007. Since his high school graduation in 2007, he has participated in OKI activities as an organizer and coach whose main contribution is in organizing OKI alumni resources. Apart from his activities in OKI, he is currently a penultimate year computer science student at Nanyang Technological University.