Domesticating the Kangaroo at BRG Keplerstrasse

by Robert Geretschläger
Breunergasse 23
A-8051 Graz, Austria
geretsch@borg-6.borg-graz.ac.at
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Introduction

This is the story of a school math contest. It is not a research-packed scientific magnum opus by any means, but rather one lone math teacher's reminiscence on three years' worth of general level math contests. Although I will try to stick to the facts as much as possible, what I plan to say is derived from my own experiences and reflects my feelings and emotions in dealing with mathematical as well as organizatorial problems, not to mention students, their parents, and (sometimes the most difficult of all) my own colleagues.

I hope that this paper will be of some help to anyone planning a similar project, and that it will also help stimulate discussion on similarities and differences between the way things work in Austria and elsewhere. I feel that some of the things I experienced would not have happened in a comparable way if I had been holding the competition in another country, and I believe it can be very informative to think about the advantages and disadvantages of different school systems and cultures as they relate to mathematical competitions.

A short disclaimer seems in order here. The Austrian school system is a good one, and most teachers in Austria take their work seriously and do it well. If some of my comments seem to indicate the opposite, this only comes from frustration in dealing with certain details and certain people, and should not be taken as a negative indicator of the whole school system. On the contrary, a project such as the one I describe is only possible in a well functioning frame-work, and my comments should be read with this in mind.

Math Contests in Austria and at BRG Keplerstrasse

In order to help a reader of this paper understand the situation I am confronted with on a daily basis, I would like to first describe a few basic facts about the Austrian school system in general and the Bundesrealgymnasium Keplerstrasse 1, Graz (or BRG Kepler for short) in particular.

In Austria, all students attend a common primary school for four years from ages 6 through 10. After this, students must choose one of two possible levels. Students planning to learn a trade attend one type of school ("Hauptschule" or "Neue Mittelschule"), and students planning an academic career attend another ("Gymnasium" or "Realgymnasium"). (It should be noted that there are all sorts of ways students can switch from one type of school to the other if they wish. The basic two-tier principle holds, nevertheless.)

Students in the academic stream will typically visit the Gymnasium for eight years (al-though more than a few are obliged to repeat a year or two), finishing with the "Matura", a final examination in a number of subjects including mathematics, the completion of which simultaneously bestows the right to attend university (which is free of charge in Austria, by the way).

Mathematics competitions are only held in these academically oriented schools, and not at very many of these. The national mathematical olympiad is organized through courses held at these schools, and penetration is not very thorough, to put it mildly. In fact, of the nine Austrian provinces, two had no preparatory courses at all this past school year, and four more had only two or three courses running. Altogether, this past school year there were only about forty such courses in all of Austria. (For more information about the organizational structure of the Austrian mathematical olympiad, see [1] and [2].) In fact, due to budgetary restructuring, less and less money is being alotted for such courses every year, and due to various other constantly mutating bureaucratic restrictions (remember, Kafka was Austrian), less teachers are willing to take on the added work load involved with teaching such courses every year.

Despite all of these problems facing the Austrian olympiad efforts, a number of additional regional and local competitions have developed in recent years. Mostly, the motivation behind these was getting students interested and involved in the olympiad (see [1]). Graz has also been taking part in the Tournament of the Towns, giving many students who would normally not have the chance to compete internationally a perspective on mathematics that reaches beyond their own borders. All of these efforts have lead to increased participation in all mathematical competitions (and particularly the olympiad) in many of the participating schools, but these are very few in relation to the total number of schools in the country. (Perhaps it should be mentioned here that an attempt is also being made to popularize the International Mathematical Talent Search in order to reach some students who would normally have no access to the various competitions, but this is proving very difficult.)

BRG Kepler in particular has been very active mathematically in recent years, and has been able to harvest the fruits of its labors very nicely. (As an example, of the 35 students qualified for the third and final round of the national olympiad this year, 6 were from BRG Kepler alone, with two advancing to the Austrian IMO team.) Ever since the inception of the Austrian mathematical olympiad 29 years ago, BRG Kepler has been right in the thick of things, especially due to the efforts of Erich Windischbacher, who has been involved at the highest level of the olympiad from the start, and has also been personally responsible for motivating many younger colleagues (including myself) to become involved in the competitions scene. Many BRG Kepler students have qualified for the IMO, and through their involvement with the mathematical olympiad, it seems fair to say that more students were motivated to mathematically related studies after graduation than might otherwise have been the case.

Currently, three teachers are actively involved in training students for the olympiad, with several more helping out in many ways. Supporting the olympiad efforts is considered part of the official school "profile", making BRG Kepler one of the most mathematically oriented schools in the country, since Austria does not have anything like the mathematical schools common in eastern Europe.

Beside active participation of students in the Olympiad and the Tournament of the Towns, the school regularly invites students from eastern European partner schools (Baba Tonka in Russe, Bulgaria; Kíliangymnasium, Diosgyör, Hungary; Jakub Škoda Gimnazium, Přerov, Czech Republic; as well as students of Marcin Kuczma from Warsaw, Poland) to participate in regional contests. Students from BRG Kepler have also taken part a number of times in a regional competition in Mezökövesd, Hungary. For the last two years, the school has joined the M. Koperník Gimnazium in Bílovec, Czech Republic and the Liceum Josef Słaskiego in Chorzów, Poland in a mathematical competition (see [3]), and a similar contest with two other schools from the region was initiated this past year for younger students. In summary, it can certainly be stated that mathematical contests are quite well established at BRG Kepler, and that a fair number of students and teachers come into contact with these activities at one point or another during the course of a school year.

Enter the Marsupial

I first heard of the Kangourou des Mathématiques when I visited ICME 7 in Québec. Until then, I had no knowledge of any of the broadly based mathematics competitons such as the Australian Mathematical Contest or the UK Mathematical Challenge, even though I had by then been actively involved with the Austrian Mathematical Olympiad for about ten years. I was quite impressed with the numbers of participants these contests were able to get involved, and felt that something similar could help popularize mathematics in Austria as well. I was quite aware of the problems that would be involved in introducing such a thing in Austria, however. Academic competition is considered suspect by a majority of students and teachers alike, and a national competition of this type involving all or at least most schools would be very difficult to find political support for. I therefore didn't spend too much time thinking about the possibilities, although I did talk about the idea of such a competition with several colleagues upon my return home.

Two years later, at the WFNMC meeting in Pravetz, Bulgaria, I met Josef Molnár from Olomouc in the Czech Republic. In the meantime, the Kangourou competition had become more and more international, and he was in charge of the Czech efforts to take part. It was from him that I received a full set of problems, namely those posed in the 1995 competition in the Czech Republic. (For those not familiar with the competition, each country is at liberty to change a few of the common questions to better fit local conditions.) The problems were in Czech, of course (a language I had no knowledge of at the time, and very little now), but armed with a Czech-German dictionary, I was able to translate the 90 problems for the three age groups represented in our school. (Actually, there are four such age groups in our school, but since very few of the older students are still in school at the end of the year, I did not bother to translate the problems for the oldest group, giving them the problems for grades 9-10 instead.)

At the time, I wasn't really too sure how I was going to use these problems in school, but I did know that I wanted to try out how average students in Austria, with no special preparation for mathematical competition, would react to such a thing. In my opinion, it seemed that solving such a problem set should be an enjoyable experience for a fair number of students, a fact that should help popularize mathematics a bit, in contrast to the usual cliché spread by so many, that ours is a dull and uninviting subject.

Setting Him Loose in School

I knew that I wanted to use the problems, but my initial idea was just to try out the reaction to them in classes that I taught myself, and possibly get a few intersted colleagues in on the action. When I told them what I was planning, however, the idea was immediately born to try out the competition in the whole school, with much of the staff helping out.

In order to understand what this meant, we must consider for a moment the delicate ego of the Austrian Teacher. Even more so than in other countries (I may be mistaken here, but I have visited schools in many different countries, and the Austrian species of pedagogue seems to me to be an especially fragile variety), teachers here do not like being told what to do. The Austrian school system allows an extremely high level of autonomy for each individual teacher to decide on teaching methods, and to a certain degree even on what is to be taught. Although there is a required general syllabus (quite a complicated one, actually), it allows a great deal of freedom in these respects. Also, there is no such thing as a coordinating department head, and even teachers teaching the same subject at the same grade level at the same time in the same school will generally not coordinate their efforts in any way. As a matter of fact, it is not likely that one will even know what the other is doing at all, unless they happen to be personal friends comparing notes. If they do something like this, it is out of an individual belief that it is a good idea, and not because they are in any way required to.

Also, teachers at the Gymnasium level in general do not like to get involved in subjects other than the ones they themselves teach (most teachers teach two different subjects). The concept of teachers of different subjects working together on specific projects is very much in its infancy, although this type of teaching is being actively encouraged by the school boards and ministry of education.

The idea in our school was to hold the competition on a school-wide basis on one day during the penultimate week of the school year. Again, some explanation of the quirks of the Austrian system is in order here. During the last two weeks of every school year (this would mean the last week of June and the first week of July in Graz; there are small regional variations), normal classes tend to break down. Officially, there is still normal teaching going on, but due to legal restrictions, the students' grades for the year have already been set by then (the students must be given the opportunity to file an official protest against failing grades before the report cards are handed out). This means that most students no longer expect to engage themselves in any relevant intellectual manner, and so teaching during this time turns into a combination of showmanship and wild animal taming. Holding a normal class becomes next to impossible, and students must be motivated for each separate period by more spectacular methods than usual. Some teachers try to circumvent the difficulties by not teaching at all during this time (the VCR becomes a very popular didactic tool), but this is boring for the students as well as the teachers, and students tend to hope for something interesting to happen.

Our hope was that holding a school-wide mathematics competition would be out of the ordinary enough to stimulate some interest. Indeed, speaking with students, it became immediately obvious that a large portion of the student body would be thankful for an activity like this during the "dead" period of the school year. Many teachers of different subjects agreed, and so it was decided that a day would be set aside for our first "Känguruh Versuchsbewerb" (Kangaroo Trial Contest), as we called it.

Of course, it was up to me to arrange all the necessary paper work, and so I spent quite a bit of time at the photocopier producing problem sheets, answer sheets, lists of rules for the teachers, and so on. Fortunately, a number of colleagues were willing to help with the other aspects of organization, and I will try to list these as best I can.

First and foremost, I should mention our school administrator, without whose clerical help the competition simply would not have been possible. The administrator in an Austrian Gymnasium is something like a vice-principle. He or she (in our case it is a "he") is in charge of all the organizational aspects of the school day, including arranging and rearranging time tables when teachers are not available for their regular periods. It is important to note that the school administrator is simply a regular teacher, a part of whose job it is to do these things (in exchange for less hours of teaching duty). He is not a superior of the other teachers the way the principle is, and must count on the good will of his colleagues to ensure his decisions are actually carried out. Our administrator assigned a specific teacher to each of the 22 classes taking part, and it was the duty of each teacher to hand out the papers, explain the rules of the competition to the students, sit in the class for the 75 minute duration of the contest to make sure the rules were followed, and finally to add up the points for each student and bring the papers to a central area, where the results were entered into a computer. Not all of the teachers assigned to a class were happy about this. Fortunately, no one went so far as to refuse to take part (they would after all otherwise have to prepare classes for that day, which would be much more work under the circumstances), but some did practice passive resistance, more about which I will mention further down.

Another colleague whose help was very important in making the competition possible was our main PC-network coordinator. He found some students willing to help with the final tally of the results, which meant preparing student lists for each grade (this was not actually difficult, as the lists were already available in computer-ready format). These lists were prepared in such a way that it would only be necessary on the actual day of the competition to enter each student's score and press a button, yielding the ordered results for each grade. In this way, producing the results lists for each grade level was quite simple and not very time consuming.

Also, a number of colleagues (and a few students) helped with the tallying of the results, beyond their "official" duties in their assigned classes. This meant that we were able to be completely finished with the contest in the early afternoon of the contest day.

The school's parents' association gave us some money, so that we were able to give the best four students in each grade level prizes in the form of book coupons redeemable at a local bookstore. Also, the best five students in each grade level received diplomas, which I prepared myself on the computer.

In order to prepare all of the teachers for their roles in the competition, I held a 20 minute talk at the staff meeting which took place the week of the competiton, explaining all of the rules and details.

The First Contest

Finally, the actual day of the contest came. Piles of photocopies were prepared, the contestant lists were humming in the school PC's awaiting the scores, and the students were sitting in their home-rooms more or less anxiously expecting their teachers. Well, most of them were.

All of the advertising (I had put up posters as well as spreading the news by word of mouth) and all of the talks with colleagues couldn't prevent several of the classes from going on field trips that very day, and many of the students in the higher grades simply decided on their own that they had more important things in their lives than to go to school that day. (This is another thing I am sure must be unique to Austria. After the students' marks have been set, students are theoretically still obliged to attend classes, as they are elsewhere. In practise however, if they decide not to, there is really nothing that can be done about it. This is especially true if their parents agree that going to school during this time is pointless, and this is a strangely common occurance.) The graduating classes were long gone anyway, and so only about $\frac{2}{3}$ of the student population actually showed up to write the contest.

Among those that did show up, the atmosphere was a strange mixture of anticipation and bemusement. A few students, especially among the younger ones, were openly excited and really looking forward to the contest. Most however, were carefully avoiding an open show of emotion, lest they appear un-cool. Also, a very small number of mostly older students was openly derisive.

Unfortunately, as it turned out there were a few teachers who were just as openly derisive, but only in front of the students. They had not said a negative word about the contest to my face, but as they were handing out the papers, I was later to learn that they were also telling the students that all of this was just a stupid waste of time, and there was no need to take it seriously. As a result, none of the students in these classes did take it very seriously, and none got a score better than 45 (recall that the maximum possible is 120, with 30 points being awarded for an empty paper). Also, these classes were finished, with their papers handed in, and out of the building in 15 minutes, even though the rules sheet I had prepared explicitly stated that they were supposed to remain the full 75 minutes.

This was also a problem in other classes. Even with me having gone out of my way to explain to the teachers that the allotted time was *exactly* 75 minutes, no more and no less, most teachers would accept papers at any time and let students go home when they were "finished". As a result, not only did many students not think through the problems at all, but there was also a problem with students talking and making random noise in the halls, making it much more difficult for the other students still working to concentrate.

A further major problem we encountered was due to an error judgement I had made. In order to facilitate tallying of the points, I had handed out both a list of all the correct answers and a transparency with marked answers to each teacher. The idea was that each teacher would simply lay the transparency on each answer sheet and count off the number of correct and incorrect answers. While this turned out to be quite a good method of checking the papers, a few teachers left either the lists or the transparencies or both lying out in full view of the students sitting in front.

In two cases this was probably done on purpose, but an unfortunate number of teachers was simply sloppy in this respect, leading to a number of disqualifications when the cheating became apparent. Unfortunately, several students were not actually caught in the act. They were however honest enough to confess after seeing that they would have won a prize, which they realized was not rightfully theirs. But were they all this honest about their dishonesty? There was no way to tell after the fact. Also, some of the teachers did not actually pay any attention to what the students were doing, and spent their time engrossed in some reading material or actually left the room. As a result, it was possible for students in some of the classes to copy answers from others, resulting in yet more falsification of the results. Unfortunately, this is just one aspect of the idea prevalent in Austria, that cheating is not immoral, but rather a game to be played, to see if it can be gotten away with. If students cheat on written exams in school, this does not lead to any punishment more serious than having to take the examination over. There is no moral aspect involved as far as it concerns most students, or teachers for that matter.

Eventually, all classes were done, and each teacher had checked the results with the prepared transparencies as requested (about 15 minutes' work per class). Unfortunately the system proved too difficult for two colleagues to understand, and I had to redo their classes' results. All in all however, this aspect went quite well.

The lists were made, diplomas printed and signed, and prizes handed out. As an additional bonus, I handed each prize winner a form to fill out, so that they could register for the next school year's olympiad preparatory course. Obviously, not all of the prize winners would actually attend the course come fall, but a few additional students were gained for the courses in this way. It was very interesting seeing the students' faces as I handed them their prizes and these forms. I made sure to do this in front of their respective classes, and getting something like this in front of their peers made for some strange reactions.

Some of the students felt genuinely uncomfortable at being in the top five of such an academic contest. This may have had to do with some of them getting their scores in a less than honest manner, but some were simply embarrassed for being better than the others. Most were openly happy, though, as one would expect. It was interesting how many students couldn't believe that I was suggesting that they should visit the olympiad preparatory course in the fall. They would giggle or smirk, but I could tell that most of them were flattered. After all, some of them had better scores than some of the students who *had* visited the courses that year.

All told, I believe that first year was a success, despite the negative things I described here. (I remind the reader of the disclaimer at the end of section 1.) Most of my colleagues agreed, and although I had been planning for this to be a one-time thing, it was generally agreed that we should do something like this every year.

A Few More Contests

Since then, we have held the contest in a similar manner two more times. Each year, we use the last year's problems. In 1997 I again translated the Czech version, but this year I was able to use the German version, which Norbert Grünwald from Wismar, Germany was kind enough to supply me with.

Of course, each successive contest means that I have learnt something from the mistakes of the one before. For instance, the second time around, I did not hand out any lists of solutions beforehand, but rather went around from class to class during the last 15 minutes of the competition, to make sure that none of the students were tempted by an inadvertant glimpse. This didn't quite work either, because teachers were once again accepting papers early, and letting students go home. This meant that some of these colleagues were angry at me, because they weren't able to check the results yet when the classes had gone, and no amount of explanation on my part could convince some of them that it was their own fault for having let the students go home early.

This year, the problem was solved by not giving out the solutions in advance at all. They were available at the end of the designated time period in one of our central computer rooms. Also, the students were not able to go straight home, because all classes still had church services, or one more period, to attend after the competition. This was much better, and the result was not only happier students, who felt the competition was more fair, but also less papers handed in with a lower point score than they would have achieved with an empty page.

Unfortunately, I made a little boo-boo again, putting down the wrong answers to five questions on one of the transparencies. This only meant that I had some extra work to do the day after the competition, however, since I had to check all the relevant papers and rewrite some of the results lists.

Conclusion

After doing this three times, what have I learned? Well, my main goals were achieved. Many students that normally don't like mathematics at least enjoy the subject a little bit in this puzzle type of context. More students take part in the preparatory courses for the olympiad, and we know exactly which students it makes sense to invite to participate in further mathematical contest activities. Perhaps most important of all, one day of dead air at the end of the school year is filled with an academically relevant activity. There are those few negative aspects that I have mentioned, but I beleive the positive side by far outweighs those.

Perhaps Austria will eventually be able to participate outright in the Kangaroo Contest, although this still seems a way off. A discussion has broken out in our math department concerning the preferability of holding the contest earlier in the school year for academic reasons, which could make such participation a possibility. Right now, a few other schools in the region are already doing something similar to what we are doing, getting the problems through me. In the next few years, however, I expect to continue with our internal school Kangaroo, knowing that most of the students and teachers at BRG Kepler are being nudged in the direction of seeing more positive aspects in mathematics than would otherwise be the case.

Literatur

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