

Canadian Math Kangaroo Contest Meeting

Organizers:

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The Canadian Math Kangaroo Contest (CMKC) meeting took place in May 2022. The format of the meeting was hybrid with a total number of participants 28, of which 16 in-person and 12 virtual. The meeting was generously supported by BIRS and CMKC. BIRS provided the venue for the workshop, CMKC supported travel and meals of participants. Contest representatives from a number of Canadian cities (Calgary, Edmonton, Lethbridge, Regina, Brandon, Ottawa, Montreal, Toronto, Thunder Bay, Orillia) and two guests from United States and Puerto Rico attended the workshop in-person.

1 Overview of the Field

Math Kangaroo is an annual international math competition for school students. This is one of the world's largest math competition, with about six million participants worldwide. The main purpose of Math Kangaroo is to introduce participants to math challenges in an enjoyable way, thus, inspiring their further interest and advancement in mathematics. It provides participating students with great and valuable experience in competitive math.

The Canadian Math Kangaroo Contest (CMKC) non-profit organization administers the competition in Canada. CMKC aims to dispel the myth that mathematics is inaccessible and difficult by using an all-inclusive and open mathematics competition to create a positive environment that emphasizes the practical and fun nature of mathematics. Since joining the International Association "Kangaroo without Borders" in 2006, the CMKC has formed hosting partnerships with multiple universities and prestigious organizations across the country.

Since its inception, the CMKC has found many ways to expand the reach and scope of its unique program, and to build new, complementary programs based upon the competition. Over the past 17 years, the CMKC has grown significantly from its humble beginnings with approximately 300 participants at 3 locations to over 6500 students participating every year nationwide in more than 50 locations in 9 provinces across Canada. Thousands of students are involved in various training and learning activities on a regular basis.

Math Kangaroo contest is unique to Canada. Students can participate in Math Kangaroo independently of their home school's involvement. Math Kangaroo Centres in Canada typically are universities. Almost all other competitions run through schools. Math Kangaroo is still one of the very few math contests available for Canadian elementary students. During the last three years, 2020-2022, the contest was offered in online format, due to the Covid-19 restrictions.

While the reputation, the merit, and the quality of inspired learning are at a very high level, the atmosphere on the contest day is unique compared to most of the other contests. The Canadian Math Kangaroo program contributes to the science, engineering and education communities through its activities that revolve around the contest but go far beyond its organization.

2 Recent Developments and Open Problems

The workshop was intended for mathematicians and mathematics educators involved in the CMKC. The purpose of the meeting was to evaluate the current state and chart the future course for Math Kangaroo in Canada. Specifically, the CMKC-BIRS meeting aimed to achieve several objectives, as listed below.

2.1 Designing new contest problem proposals

These presentations and discussions aimed to encourage CMKC members to submit problem proposals for future competitions. Therefore, the meeting planned introduction to the KSF curricula, presentation of proposal examples by topic (arithmetic and algebra, numbers, geometry, logic), and tutorial on software tools for vector graphics. Proposed Math Kangaroo problems are expected to be creative, interesting, original, and provoking mathematical and logical thinking.

2.2 Hosting the Annual Meeting of Kangaroo Sans Frontiers (KSF)

In 2021, the CMKC team applied for hosting the annual meeting of the international association KSF in Canada, either in 2026 or in 2027. CMKC invited two KSF board members who represent United States and Puerto Rico in KSF. They hosted the KSF Annual Meeting in 2014 and 2019 and could share their experiences with the CMKC team. Thus, the Canadian team could learn important information about what the organization of the meeting would involve.

2.3 Programs for teachers and students

CMKC team has always sought ways to serve the community through its programs. The organization offers online classes for students and publishes mathematical resources on a regular basis. Other content includes development of videos on math topics posted on the Math Kangaroo eLearning YouTube channel [1]. The 2022 CMKC-BIRS workshop gave opportunities for the group to have discussion and plan delivery of programs for teachers, including teacher workshops delivery and mathematical material creation.

2.4 Analyzing results from past contests

Important future work the team plans to undertake is studying and analyzing the results from past contests. This research involves examining available data from the past nine years (2014-2022) and getting insights into challenges students face with particular math concepts. The outcomes of such study can be used for improving the training programs.

2.5 Development of math learning and testing tools

Self-testing educational software tools can assist students in learning mathematics. Collaborative research involving online and adaptive learning software such as the QuizMAster tool [2] has the potential to contribute to the development of mathematical training mobile / web application.

3 Presentation and Discussion Highlights

The workshop consisted of several presentation and discussion sessions on topics of interest to the organization and the workshop participants.

- Friday, May 6:
The evening session consisted of informal discussion on past contests and math training programs.
- Saturday, May 7:
The morning session started with presentations of the Math Kangaroo curricula for all contest levels, namely: 1-2; 3-4; 5-6; 7-8; 9-10; 11-12. This introductory session was followed by a presentation by

Valeria Pandelieva, who gave an overview of the competition, including its history in the world and in Canada. She also spoke about Math Kangaroo problems and topics, providing specific examples.

The afternoon session included four presentations with discussions. Joanna Matthiesen and Luis Caceres gave a talk on what hosting of the KSF Annual Meeting involves. Fushua Lin gave a presentation with a title Adaptive QuizMAster, followed by demonstration of the QuizMAster. Gautam Srivastava led a tutorial on software tools for vector graphics, covering LaTeX TikZ, GeoGebra, and draw.io. This tools are needed for creating good quality graphics for the competition and math training materials. Agnes Fung presented the CMKC website most recent updates.

On Saturday evening, the participants discussed what new programs CMKC can bring to teachers and students in near future. Everyone agreed that training programs for teachers are of very high priority.

- Sunday, May 8:

The last two sessions on Sunday were used for demonstrating additional examples of problem proposals and plans for analyzing of results from past contests. Ildiko Pelczer presented ideas of problem proposals in various contexts: transformation; exchanges; processes; folding; equations; and configurations. Rossitza Marinova concluded the workshop with a talk on plans for how the CKMC team can work on analyzing results from past contests.

4 Outcome of the Meeting

The two-day BIRS workshop facilitated discussions and decisions on how to further improve the organization of the Math Kangaroo contest and accompanying programs.

The meeting is another significant milestone for the Canadian Math Kangaroo Contest team. Representatives from various provinces and countries exchanged ideas and discussed issues. The major meeting outcomes include planning future work for:

- Improving the quality of the mathematical content offered by the Math Kangaroo contest.
- Fostering of wider involvement from the CMKC community in proposing problems.
- Collaborating for research into competitive mathematics, such as math training tools and data analysis.

Sharing information and ideas is crucial for maintaining a program of such scope, diversity, quality and continuity. The CMKC meeting at BIRS facilitated efficient collaboration, coordination, and knowledge transfer among Math Kangaroo national and regional organizers.

References

- [1] Canadian Math Kangaroo eLearning, Videos, <https://www.youtube.com/channel/UCClduqySeICLcuRPEquxfaw/videos> (2021-2022).
- [2] Dutchuk, M., Mohammadi, K.A., Lin, F. QuizMAster—A multi-agent game-style learning activity, International Conference on Technologies for E-Learning and Digital Entertainment, *Lecture Notes in Computer Science*, **5670** (2009). Springer, Berlin, Heidelberg, 263–272.