International Judging System of Figure Skating: A Middle Grades Activity on Decimal Operations

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Abstract

A skating judging activity suitable for middle grades students is presented as a model through which students can learn mathematics. The activity involves students' rating a pairs team's performance and computing the team's score through a simplified version of the International Judging System (IJS). In this presentation, the scoring of the art of figure skating is explained mathematically.

Introduction

In this presentation, you will find a brief overview of the shortcomings of the 6.0 judging system used at the 2002 Winter Olympic Games, an explanation of the new International Judging System, and a middle grades mathematical activity that uses the International Judging System as an application of decimal operations. In 2002, the figure skating judging system most recently underwent a complete revision in 2002 to a system that assigns decimal values for the difficulty and execution for each completed technical element – essentially mapping the artistic sport of figure skating to a mathematical model.

Pairs Skating Performances

Pairs teams consist of a lady and a man skating together; pairs skaters attempt to skate in unison, glide across the ice with power, project the mood and storyline of their music, and implement creative choreography to their music. Pairs skaters' artistry and technical difficulties are scored by judges. All of the pairs technical elements fall within eight categories: lifts, throw jumps, pairs spins, side by side spins, side by side jumps, footwork, spiral sequences, and death spirals. Within each category, there are multiple variations. For instance, there are several categories of jumps that can be performed: toe loop, salchow, loop, flip, lutz, and axel; jumps are identified based on the takeoff entrance that the skaters use (forwards or backwards, inside or outside edges). Each of these jumps can be performed with one through four revolutions in the air; the more revolutions achieved, the more difficult the jump. The execution of each technical element can be assessed – for example, jumps can be assessed according to the take-off, mid-air position, height achieved, revolution speed, and landing. Note that pairs performances may have changed as a result of teams' trying to optimize their scores under different scoring schemes and / or create more innovative storylines, but the required technical elements for pairs performances have not been significantly modified.

Middle School Activity: "You be the judge!"

McDuffie [1] suggests that teachers should consider how they can adjust mathematical tasks to meet the needs of their students. One suggestion is to help students understand the contexts in which the tasks are situated, and possibly even change the contexts to make them more familiar to students. A second suggestion is to incorporate overarching goals into instruction of mathematical tasks; tasks may not explicitly address some learning objectives, but teachers can emphasize relevant learning objectives when implementing tasks. In this section, I demonstrate an activity through which I combined McDuffie et al's [1] two suggestions in my teaching practice. I agree with the concept of making contexts more familiar to students, because this can help them relate better to the data being presented to them for analysis. But, I also believe in introducing students to new contexts within their grasp of understanding. Explaining new contexts can also help students learn Common Core State Standards [2] for mathematical practice, which I view as my overarching goals for a middle grades mathematics classroom.

With these ideas in mind, I prepared a classroom activity for middle grades students addressing the Common Core State Standards [2] content areas of Data Analysis and The Number System, specifically, on practicing finding averages, rounding decimals to the nearest whole number, adding decimals, and interpreting information from tables. My overarching goals included having students learn a model in which mathematics is heavily used (in the context of figure skating judging) and having students attend to precision (e.g., what does each row and column of a table mean, and how can we use it?).

In the activity, I first ask students to watch a video of my pairs figure skating, and judge each of the twelve listed elements on a scale of -3 (not done well) to +3 (done well), as if the students are official judges of figure skating. They then average their scores with those of classmates, similarly to how figure skating judges' scores are averaged. Students then round the averages to the nearest integer and find the corresponding technical element scores for each of the elements. The sum of the technical elements is the score that the students assign for the program.

Although none of my students were previously exposed to the context of figure skating judging, they could relate to the context as figure skating is one of the most popular winter Olympic sports to watch. The students were able to apply their knowledge of averaging numbers and reading tables to the context and saw a model for math's usage in a realm different from what they normally see.

Extension Activities to "You be the judge!"

In addition to completing the activity, teachers can pose further questions to help students make sense of the mathematical model that the International Judging System affords. The following are some suggested questions:

- Why do you think averages are used in the figure skating context? What might be the effect of adding a larger number of judges?
- How might scores and placements change if the judges rated the execution of each element from 0 through 6, or from 1 to 7, rather than from -3 to +3?
- Why are we using rounding to integers as the preferred level of precision for this activity? How might we use rounding to tenths to obtain scores from the table?
- According to the Scale of Values, what are the most / least important pairs elements for pairs teams to practice, and why?
- The Scale of Values table representation was chosen by the International Skating Union to show skaters the elements and their associated scores. In what other ways could the information in the Scale of Values be organized?
- What are some benefits and drawbacks to mathematical scoring of figure skating programs?

Other Olympic sports such as gymnastics, diving, and ski jumping have similar scoring systems where the athlete's technical skill difficulty and the execution of that skill are taken into account. In order to succeed in such sports, athletes need to understand how to balance performing difficult skills with clean execution. Students could be asked to compare the different scoring systems of sports to further explore how knowing mathematics can help athletes in their daily practice.

History: The 6.0 Judging System

Under the 6.0 judging system, judges ranked each pairs figure skating team against the other; namely, if there were 20 pairs teams competing in an event, judges ranked each team from 1 through 20 in the short program and again ranked each team in the long program. In order to determine the teams' ordinal placements, the team with the highest number of first place votes places first, etc. In the case of a tie, the team with the lowest sum of votes places first. If there is still a tie, the two teams each earn the average of the two tied placements' ordinals; for instance, if there is a tie for first place, then both teams earn (1 + 2) / 2 = 1.5 points. Additional tie-breaking procedures are described by Sadovskii & Sadovskii [3].

To illustrate the use of the system, the judges' placements of two pairs teams' short programs from the 2002 Olympic Winter Games, Elena Berezhnaya and Anton Sikharulidze (representing Russia) and Jamie Sale and David Pelletier (representing Canada) are provided in Table 1.

	Judge #								
	1	2	3	4	5	6	7	8	9
Berezhnaya / Sikharulidze	1	1	1	1	1	2	1	2	1
Sale / Pelletier	2	2	2	2	2	1	2	1	2

Table 1: *2002 Olympic Winter Games – Pairs Short program judges' placements.*

Berezhnaya / Sikharulidze earned seven first place ordinals while Sale / Pelletier earned two first place ordinals; thus Berezhnaya / Sikharulidze placed first in the short program. In order to determine a team's overall placement at the event, the team's short program ordinal placement would be multiplied by 0.5; and the team's long program ordinal placement would be multiplied by 1.0. The team with the lowest point sum of short and free skates would be declared the winner of the competition.

At the 2002 Olympic Winter Games, Berezhnaya / Sikharulidze and Sale / Pelletier tied in the long program, thus each team earned 1.5 points. To compute the overall placements for each team, we apply the calculation, 0.5 * (short program ordinal) + 1 * (long program ordinal) for each team:

- *Berezhnaya / Sikharulidze: 0.5 (1) + 1 (1.5) = 2.0 points*
- *Sale / Pelletier: 0.5 (2) + 1 (1.5) = 2.5 points*

Thus, since Berezhnaya / Sikharulidze earned fewer points, they were declared the gold medal winners of the pairs event at the 2002 Olympic Winter Games, and Sale / Pelletier were declared the silver medal winners. However, the pairs event chief referee was not satisfied with the results; during their long program free skate, Berezhnaya / Sikharulidze made many obvious errors and Sale / Pelletier skated a flawless program. Upon investigation, it was revealed that a French judge Marie-Reine le Gougne had been pressured give the Russian pair team a higher score irrespective of their actual performance [4]. If the French judge had given Sale / Pelletier a first place mark, then instead of having a tie for first place in the long program, Sale / Pelletier would have placed first and Berezhnaya / Sikharulidze would have placed second. The new calculations for total points would be the following:

- *Berezhnaya / Sikharulidze: 0.5 (1) + 1 (2) = 2.5 points*
- *Sale / Pelletier: 0.5 (2) + 1 (1) = 2.0 points*

This would reverse the placements. But, since Berezhnaya / Sikharulidze were not accused of any wrongdoing, they were allowed to keep their gold medals and Sale / Pelletier were awarded duplicate gold medals.

The New International Judging System: Mathematical Model Explained

The 6.0 judging system had several shortcomings. The most prominent shortcoming, as seen from the example at the 2002 Olympic Winter Games pairs event, was that the biases of one judge could influence the resulting medal winners at an event. Another shortcoming was that judges had to score teams' entire programs as a whole and could not award credit for each technical element completed. At an event like the Olympic Games, where there were 20 pairs teams, the long program event lasted more than two hours. Judges had to rely upon their memory to rank the team that skated 20th against a team that skated two hours earlier; this was not a reliable way of assuring that fair scoring had taken place.

Under the new International Judging System of figure skating, judges must rate the execution of each element of a team's program on a scale of -3 to +3. This rating takes place on a computer keypad as soon as the element has been completed, and the rating only applies to the element at hand. The multiple judges' ratings are then averaged to give an execution score for each element that the skaters perform. Based upon the execution score of -3 to +3, as well as the difficulty of each element, skaters receive a technical element score for each element [5]. The sums of the technical element scores form the team's score for the program (Note: for simplicity, only the technical element score is discussed in this presentation. Another score is also considered, the Program Components score.). Teams are then ranked according to their scores: the team with the highest score is the winner of the event.

A benefit of using the new International Judging System is that since the judges' execution ratings are averaged, an outlier rating for one element does not significantly affect the outcome of the team's placement. A second benefit of using this system is that there is no need for judges to consider multiple teams' programs simultaneously. A third benefit of this new judging system is that teams can concretely know on which elements they should focus their practice; if they earned a low score on a particular element, the next time they perform their program they can aim to adjust how they perform that element. In the ten years since the IJS has begun being implemented, skaters now have learned to maximize their scores by earning as many technical points as they can without receiving deductions and by focusing more on expressing artistically to their music. In the 2010 Winter Olympic Games in Vancouver, American Evan Lysacek won the gold medal over Russian Evgeni Plushenko's because Lysacek's higher artistic marks more than compensated for Plushenko's higher technical marks.

References

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