Home Ice Advantage: Representing Numbers to 20, Grade 1

Lesley Ross and Brenda Wells

This lesson is part of a teachers' resource, Home Ice Advantage: Classroom Assessment of Mathematics. *It will be available in 2011 from the Centre for Mathematics, Science and Technology Education (www.uofaweb.ualberta.ca/cmaste/).*

This lesson is part of a professional development project on assessment in mathematics initiated by Joel Canete, Connie Farrell and Lori Weinberger, the mathematics consultants of the Fort McMurray public and separate school divisions, and facilitated by Gladys Sterenberg, a faculty member of the University of Alberta. As part of our work on assessing children's mathematical ways of knowing, we decided to create assessment tools and to implement them in the teachers' classrooms. We were inspired by the book *The Hockey Sweater*, by Roch Carrier, and created literature-based lessons that included assessment strategies, descriptions of the teaching and learning context, student artifacts and interpretations of the assessment results. We decided that the best way to increase our own understanding of classroom assessment was to visit our colleagues' classrooms during the implementation of the lessons. Both the public and separate boards of education sponsored these visits by providing teacher release time. This was a definite strength of the project as it enabled teachers to collect assessment data in their colleagues' classrooms. What follows is the lesson we designed and implemented as part of this project.

Lesson Description

Using numbers to 20, students will identify and label two complete sets of uniforms. They will determine how many uniforms will be needed in each group, offer possible solutions for identifying the uniforms and provide explanations for the identifications. This is part of the number strand. The assessment is intended to be used midway or at the end of the unit, Representing Numbers to 20. It may also be used later in the year as a means of review.

Specific Outcomes (Numbers)

1. Say the number sequence 0–100 (at this time to 20) by
   - ones forward and backward between any two given numbers.
2. Demonstrate an understanding of counting by
   - indicating that the last number said identifies how many,
   - showing that any set has only one count,
   - using the counting on strategy and
   - using parts or equal groups to count sets.
3. Represent and describe numbers to 20, concretely, pictorially and symbolically.
4. Compare sets containing up to 20 elements to solve problems, using
   - referents and
   - one-to-one correspondence.

Specific Outcomes (Patterns and Relations)

5. Describe equality as a balance and inequality as an imbalance, concretely and pictorially.

Essential Questions (Mathematical Processes)

1. How will the students communicate their understanding of counting?
2. How will the students develop connections within their understanding of number sense?
3. How will the students develop mathematical reasoning when counting and comparing numbers?
4. How will the students develop visualization skills to represent, describe and compare numbers from 0 to 20?
5. How will the students develop number sense through problem solving?
6. How will the students use mental estimation skills to compare numbers from 0 to 20?

Achievement Indicators

1. Recite forward by ones the number sequence between two given numbers (0 to 100).
2. Recite backward by ones the number sequence between two given numbers (20 to 0).
3. Answer the question, "How many are in the set?" using the last number counted in a given set.
4. Identify and correct counting errors in a given counting sequence.
5. Determine the total number of objects in a given set, starting from a known quantity and counting on.
6. Partition any given quantity up to 20 into two parts, and identify the number of objects in each part.
7. Compare two given sets, using one-to-one correspondence, and describe the sets, using comparative words, such as more, fewer or as many.
8. Determine if two given concrete sets are equal or unequal, and explain the process used.

School Context

St Martha is an early-entry elementary Catholic school with a grade range from prekindergarten children of 3½ years old (or 2½ years old with severe language delays or disabilities) to Grade 8 students. St Martha School is currently in its fourth year of operation in the newly developed area of Timberlea in Fort McMurray. There are approximately 650 students in the school, of which roughly 70 are in Grade 1. There is a mixture of low-, middle- and high-income families. There are many ESL students from around the world including countries such as South Africa, Zimbabwe, India, Venezuela and the Philippines.

Dr K A Clark School is a K–8 public school, serving students in the downtown core of Fort McMurray. This school offers many programs to help children succeed, such as junior skills and intermediate skills district programs, Native education and mentorship programs.

The Learning Plan

Task

Maurice wants to buy 20 new hockey jerseys to make two teams for the children. He doesn't know how many to buy for each team. What can he do to find out how many sweaters each team should have? How will the fans know who is playing? How will he be able to tell the teams apart?

You and your partner need to find out how many sweaters each team needs. Decide how to tell the teams apart and how the audience will know which player is wearing what jersey. Design two different team sweaters and label them accordingly.

Plan

1. Discuss background knowledge about the game of hockey. Ask students: How do you know who is playing? How many players are on each team? Do you have a favourite hockey team? Do you or anyone you know play hockey?
2. Read *The Hockey Sweater,* by Roch Carrier.
3. Ask students: What did you notice about all the players in the pictures? If you were the referee, how would you be able to tell the teams apart? What is the problem with everyone wearing the same sweater?
4. Introduce the math task for children to solve. Ask students: What do you know from the problem and what do you need to find out? Discuss with your partner what you will need.
5. Provide the children with sweater cut-outs. Each pair is to count out as many as they need (20) and take them back to their desks to decide how to divide them into two teams.
6. Once the sweaters have been divided into two teams, ask students to label each sweater with a corresponding numeral and colour code for each team's sweater. Students may choose any numeral from 0 to 20 or beyond to put on the sweater.

Assessment Strategies

(See assessment tools at the end of the lesson.)

- Rubric for direct observation
- Checklist for finished product
- Video recording of student conversations

Assessment Questions and Observations

The students were assessed while they were doing their work and after they finished. Using the rubric designed specifically for the task, teachers tracked outcome objectives and recorded general observations that related to the following questions:

a. Can the student justify his or her choice for the number of sweaters on each team?
b. Can the student explain what might happen if there is a player on one team who has the same sweater number as a player on the other team (for example, both players are a number 6)?
c. How is the child counting the sweaters (for example, one-to-one correspondence, pairs, five-frame or ten-frame arrangements)?
d. Is the child counting accurately and consistently?

e. Is the child communicating math language, demonstrating cooperation and sharing ideas? Math language examples include number words zero to twenty, count, number, equal groups, singles, estimate, more fewer, same as, equal, as many as.

Samples of Student Responses

Brenda Wells's Grade 1 classroom has 18 students (7 boys and 11 girls) and a regular part-time educational assistant. Many of the math practice and enquiry sessions that the students routinely participate in have the students working with partners or in small groups. This rich task project used a partner format with partners preassigned by the teacher. While the students were completing this assignment, three guest teachers observed the lesson. They interacted with the students by asking questions or clarifying student actions, in addition to responding to student enquires, recording observations on rubrics and videotaping the class. One student who completed the rich task assignment was Adam. At the time of the assignment, Adam was 6 years 7 months old and working at grade level in both math and language arts. Adam has two younger siblings, and both of Adam's parents work outside the home.

On this day Adam worked with his partner, counting out the sweaters and dividing them into two equal groups. When asked to count his set and describe the solution that he and his partner came up with, Adam found that he had 12 team sweaters. His partner said she tried to tell him he had too many, but he said he had counted 10 sweaters. Adam was asked to then count both his and his partner's, and he counted to 22. After the recount, Adam used mental math strategies to decide that he had two extra team jerseys. He did not hesitate to have them removed from his set. Adam was able to articulate 10 + 10 = 20 and both partners should have 10. The numerals Adam chose to write on the jerseys were very interesting when compared to those of the other students in the class. All other students either chose the digits 1–10 or randomly selected any numbers between 1 and 100. Adam used odd numbers to successfully skip count to 15. He made an error with the last two team jerseys by using 18 and 20.

Adam was not asked afterward to explain why this error occurred. Possible reasons could be that he lost his train of thought because of interruptions, or he got mixed up with odd and even numbers. It was interesting to observe that if he had been counting by twos, he would have used the last two numbers correctly. Adam had difficulty printing the number 7 with a reversal, which he self-corrected. Adam demonstrated his awareness of sports jerseys by printing the numerals on the back of the cards and making logos on the front. He also exemplified his awareness of patterns and the fraction of ½ when colouring the uniforms. Specific examples of mathematical language were not recorded; however, when discussing the project, Adam did use math language independently. Overall Adam clearly demonstrated his proficiency when using numbers to 20, solving problems and showing his work.

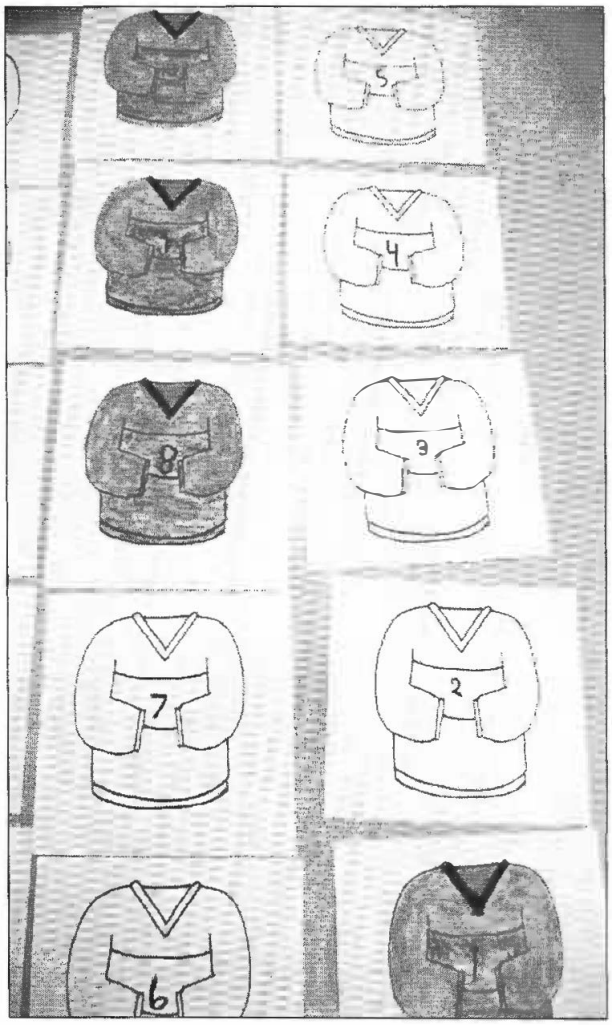
Rachel worked on the task, demonstrating that her counting and problem-solving skills were excellent at this time. She effectively counted out 20 objects and worked with her partner to produce a solution to the problem. When asked, Rachel correctly identified that the total set had 20 objects and now each smaller group had 10. She had 10 sweaters for her team and correctly labelled each with its own identifying numeral, which were clearly printed and had no reversals. Rachel selected a wide range of digits (1, 6, 9, 11, 12, 22, 36, 50, 80 and 90) showing her understanding of numbers to 100. When asked, Rachel explained her solution to the observers. Some math language was used independently but mostly this language was used only with prompting. Rachel successfully completed the finished product by producing 10 team sweaters with number labels and colouring the jerseys. The neatly completed task also indicated her familiarity with patterns, and her understanding of what team jerseys look like.

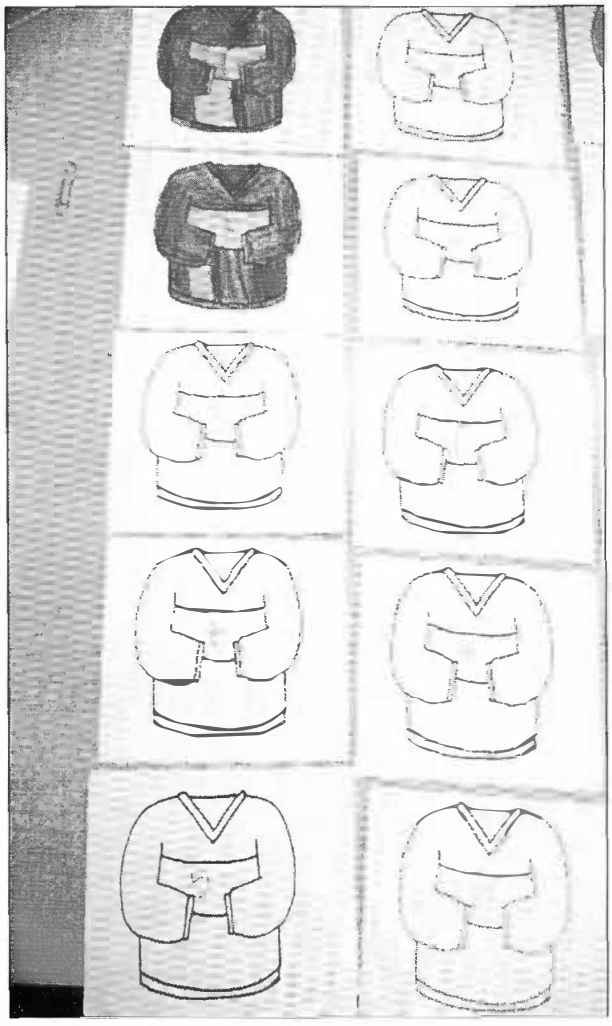
Chad and Jeff, working partners, counted 20 hockey sweaters. From the onset, this pair identified that each team would need 10 sweaters, demonstrating their ability to produce a solution to the problem using mental math. They thought they were successful at counting out the correct number of objects and dividing them into two equal groups until they were asked to show their sweaters to the teacher observing them. Chad accurately identified that his set had 10 objects and used the last number (10) as his starting place to label each sweater. He counted backward (10–1) as he labelled the sweaters. While this skill was not indicated in the assignment rubric, it is one of the outcomes prescribed in working with numbers to 20. Chad accurately printed the numerals legibly, with no reversals. When the boys were asked to count their team sweaters out loud, Jeff realized he somehow had 12 sweaters and this was more than he needed. He then discarded the two extra sweaters. In contrast to the numerals Chad selected to label his sweater, Jeff used various numbers to 100. His printing was legible and there were no reversals. With assistance, this partnership accurately produced two equal teams, and they were able to explain their solution

using some math language. Other examples of mathematical procedures and knowledge were also observed within this partnership. When asked how many sweaters he had left to colour after completing two, without going back and recounting Chad replied there were eight, thus indicating mental math procedures. Jeff counted the team sweaters by twos a few times and arrived at different answers. He then rechecked by counting by ones. He selected a counting strategy that was efficient, but when the results were different from his first attempt, he selected a different strategy to verify his answer.

Lesley Ross's class is made up of 17 Grade 1 students. Just as Brenda had prearranged partners, Lesley put much thought into matching up students into groups of two to guarantee that students would feed off one another and learn the most from this rich task.

Kadar and Bhadra were partners in completing the hockey sweater task. They seemed to work very well together. As Kadar counted out the 20 sweater cards one by one, he passed them to Bhadra, who recounted and organized the cards. When asked to explain the numbers that these partners had chosen to put on the hockey sweaters, Bhadra responded that she would label all of the sweaters with the number one. Instantly, Kadar knew that this was incorrect because, as he said, "You won't know who that is," or as Bhadra rephrased, "If the referee blows his whistle and says, 'Number one just scored a goal,' would we know which number it would be?" Without much prompting, Kadar explained to Bhadra, "You need to do different numbers than one. You did one the first time and then you can change to nine, ten, eleven or twelve." Bhadra still did not completely understand, and Kadar went on to explain, "Because when number one scores, they won't know which player scored." With a nod of her head, Bhadra seemed to understand and got back to work on the paper jerseys. The following are photographs of the jerseys that each student completed, and the rubric used to assess their work.





Representing Numbers to 20 Rubric

Partners ~~#~~ Kadar Bhadra

	Excellent	Proficient	Adequate	Not yet adequate
Count a set with one to one correspondence	Counts to 20 with no errors K ✓	Counts to 20 with 1-2 errors B ✓	Counts to 20 with 3-5 errors	Counts to 20 with greater than 5 errors
Shows that the set has only one count – the last number is how many.	Accurately identifies each set without assistance K ✓ B ✓	Accurately identifies each set with limited assistance	Requires several attempts to identify each set with assistance	Unable to demonstrate that each set has only one count
Printing the numerals – legibility & reversals	All numerals are legible with no reversals K ✓ B ✓	1 reversal and legible	2 reversals and legible	3 or more reversals and/or illegible
Able to produce a potential solution to the problem	Identifies a plausible solution independently K ✓	Identifies a plausible solution with limited assistance	Identifies a plausible solution with direct guidance B ✓	Unable to identify a plausible solution
Demonstrate how 20 items would be Divided into 2 teams.	Accurately produces 2 equal groups K ✓	Accurately produces 2 equal groups with assistance B ✓	Accurately produces 2 equal groups with direct guidance	Unable to produce 2 equal groups
Describe how the teams are balanced Or unbalanced	Accurately explains their solution to others independently K ✓	Accurately explains their solution to others with limited assistance B ✓	Accurately explains their solution to others with direct guidance	Unable to provide an explanation
Using Math Language	Uses math language independently K ✓ B ✓	Uses math language with limited prompting	Uses math language with direct prompting	Unable to use math language

10 + 10 = 20

Kadar - Once number 1-10 counted backward as he printed.
- Explained to Bhadra, why all her players couldn't be #1. She accepted his explanation.

Kadar can explain both teams are different colors so that it doesn't matter that both sets are 1-10

Bhadra - started to label all of her sweaters with #1

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Through this observation of Kadar and Bhadra, we learned that Kadar had an excellent understanding of what was expected of him in this rich task, and he had the appropriate mathematical knowledge of numbers to 20 to facilitate his success in this project. He was also able to assist his partner in realizing what was needed to complete the task. Although Bhadra required guidance, we learned that with assistance, she was able to reach a possible solution to the hockey sweater project.

Self-Assessments of the Lessons

Lesley felt that one of the strengths of the lesson was the opportunity to be in Brenda's class the previous week and to see some of the avenues the students took and where they got off-track. This helped her anticipate some of the difficulties her students might have and prompted her to attend to her directions. She focused on guiding her students to have two separate teams and reminding them that the sweaters needed to be different (but that one team needed to look the same and the other team needed to look the same). Lesley was missing almost a third of her class for the lesson, but because colleague visits had been arranged, she borrowed some students from another classroom. She didn't have enough sweaters, so she tried groups of three. She found that groups of two worked really well but groups of three were more challenging. One change Lesley would make the next time she taught the lesson would be to state her criteria and show the students the rubric and checklist. She felt this would provide students with a guide for what she was looking for.

Her assessment of student learning focused on strategies students used to meet the outcomes of the lesson. She noted that some groups of students counted and recounted the number of cards when they arrived at different totals. A couple of groups were able to figure out how many more they needed without recounting. For example, students in one group counted 17 jerseys and were able to figure out that they needed three more. Students in another group had 15 cards, and they instantly knew they needed 5. Lesley had been working with her students on double facts (2 + 2, 5 + 5) and noted that most groups figured out quite quickly that if there were 2 teams and 20 players, it was 10 and 10, and they were able to make equal groups. Another thing she was interested in observing was number formation and making sure they could form numbers. Some students doing this task were only comfortable with numbers to 20 and only formed numbers from 1–20. Other students were comfortable with numbers to 10 and wrote 1–10 on one team and 1–10 on the other team. Other kids who were excited about numbers and who had lots of experience with numbers were making up numbers up to a million.

Brenda was impressed with the students' successful demonstration of the outcomes. Drawing on their knowledge of doubles, most of the students knew that 10 + 10 equals 20, so they knew that each team needed that many jerseys. She noted that they were able to count at this point, they were able to count back from 0 to 20 and they were able to identify that each sweater needed a different number. She found it interesting to see what numbers they chose: some went 1–10, some decided they were going to skip count, some skip counted using odd numbers. One challenge was "that art became the primary process and that they wanted to decorate, so a few needed to be reminded to please choose the numbers first."

When teaching this next time, Brenda would emphasize the numbers that students needed to figure out to identify the team sweaters. She wondered if there would be a difference between the students' actions if she did the lesson earlier in the year. In particular, she was interested in knowing if they knew 10 + 10 was 20 earlier, or if they had developed that through their recent math units.

Brenda noticed that all her students counted and used one-to-one correspondence; that is, they all physically moved the sweaters and counted "1, 2, 3, 4, ..." They all knew that if they had 10 sweaters, then their set equals 10. She observed that they knew the double strategy (10 + 10 = 20), so they didn't have to stop and do "one for me, one for you, one for me" but instead they were able to figure this out in their heads. She also noticed that if they had 10, some children counted forward to 10, whereas other children counted backward and started at 10 to make sure that they used each digit only once.

Lesley Ross has been teaching Grade 1 at Dr Clark School for three years and is currently teaching Grade 1 at Beacon Hill School in Fort McMurray. Lesley enjoys teaching mathematics and especially enjoys exploring with students math concepts through a hands-on approach.

Brenda Wells is a Grade 1 teacher at St Martha School in Fort McMurray. Brenda has been teaching Grade 1 for five years and has previously taught Grades 2 and 5. Over the years, she has taught in various urban and rural communities around Alberta. She has also experienced teaching in isolated settlements in the Northwest Territories. With the development of the new math curriculum, Brenda has participated in locally offered professional development projects.

Representing Numbers to 20

Student Partners _____

	Excellent	Proficient	Adequate	Not yet adequate
Counts a set with one to one correspondence	Counts to 20 with no errors	Counts to 20 with 1–2 errors	Counts to 20 with 3–5 errors	Counts to 20 with greater than 5 errors
Shows that the set has only one count— the last number is how many.	Accurately identifies each set without assistance	Accurately identifies each set with limited assistance	Requires several attempts to identify each set with assistance	Unable to demonstrate that each set has only one count
Prints the numerals legibly without reversals	All numerals are legible with no reversals	1 reversal and legible	2 reversals and legible	3 or more reversals and/or illegible
Produces a potential solution to the problem	Identifies a plausible solution independently	Identifies a plausible solution with limited assistance	Identifies a plausible solution with direct guidance	Unable to identify a plausible solution
Demonstrates how 20 items will be divided into 2 teams	Accurately produces 2 equal groups	Accurately produces 2 equal groups with assistance	Accurately produces 2 equal groups with direct guidance	Unable to produce 2 equal groups
Describes how the teams are balanced or unbalanced	Accurately explains their solution to others independently	Accurately explains their solution to others with limited assistance	Accurately explains their solution to others with direct guidance	Unable to provide an explanation
Uses math language appropriately (for example, number words zero to twenty, count, number, equal groups, singles, estimate, more, fewer, same as, equal, as many as)	Uses math language independently	Uses math language with limited prompting	Uses math language with direct prompting	Unable to use math language

Representing Numbers to 20 Checklist
Uniform Finished Product

Student Name	Two Equal Teams	All Uniforms Numbered	Two Different Team Sweaters	Appearance/Neat Work

Hockey Jersey Template