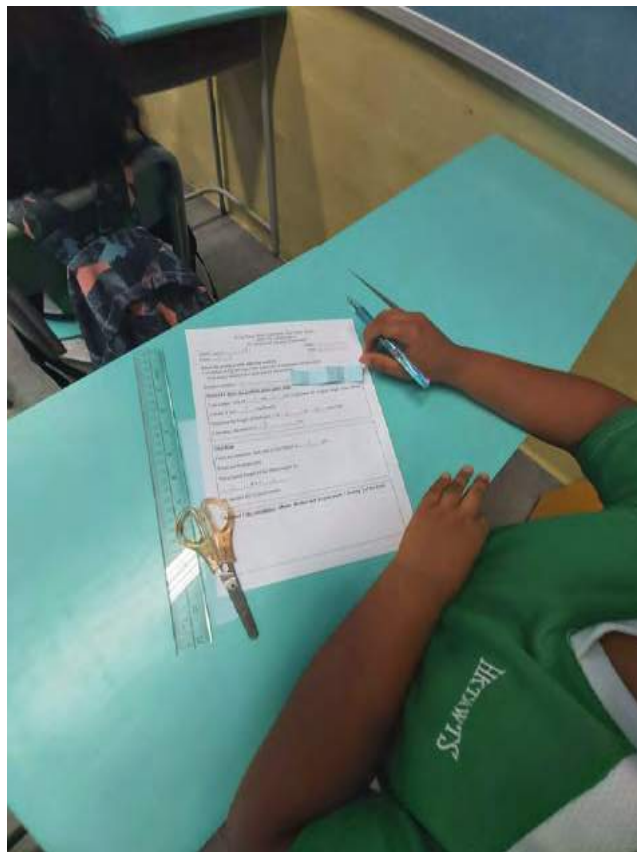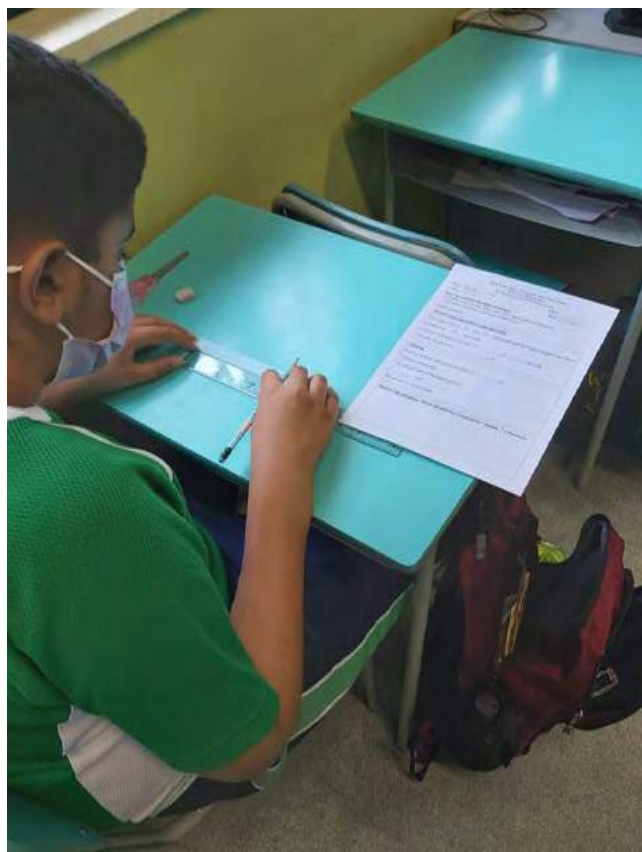# Using Paper Strips and Mathigon Applet in Solving Division of Fractions Problems

by WK Cheng

LEARNING TARGET

To solve division of fractions problems with different tools

RELATED THEME

Activity First – Instead of working on standard illustrative examples, students explored the usage of different tools, namely paper strips and Mathigon applet. Hands-on exploration helps students retrieve prior knowledge and thus develops the concepts of division of fractions. Finally, teachers explained the calculation steps in solving those problems involving division of fractions.

RATIONALE

Background

From teachers' experience, many non-Chinese speaking (NCS) students do not like drilling exercise. They like 'Learning by Doing' and learning with hands-on activities. Pictorial representation could help them understand various mathematical concepts by linking concrete hands-on experiences with abstract number concepts. Teachers also found that students were interested in solving fraction problems with different tools.

Teachers decided to introduce different tools to students in assisting them to understand word problems involving division of fractions. Two lesson designs were adopted. The first design was to represent word problems with the help of paper strips. A detailed lesson plan can be found on the resource page. In the lesson, students represented a fraction with a paper strip and explored division of fractions by cutting the strips into equal parts. The second design was to represent word problems with Mathigon applet – Polypad (Fraction Bars). The detailed lesson plan can also be found on the resource page. In the lesson, students explored division of fractions by placing different Mathigon Fraction Bars side by side.

After exploring with paper strips and the Mathigon applet, students learnt how to relate the problem to the corresponding mathematical calculation. It connects learners' conceptual knowledge with procedural knowledge.

Multiple ways of solving problems in division of fractions

1.   By calculation
2.   Using paper strips
3.   Using Mathigon applet – Polypad

Students could understand how to solve a division of fractions problem with paper strips without doing any calculation. By cutting and measuring the paper strips, students had some hands-on experience of how to relate it to the mathematical number sentence in the division of fractions. Meanwhile, students using the Mathigon applet could grasp the visual representation of division of fractions. All these hands-on tasks extended students' knowledge of division. That in turn helped them learn that the operands in division can be fractions. This demonstrates how the constructivist approach 'Learning by Doing' helps scaffold students' knowledge.

LEARNING AND TEACHING STRATEGIES

A. Learning by Doing

The idea of 'Learning by Doing' was adopted in the lesson using paper strips. Teachers taught students how to represent a fraction with the length of a paper strip. For example, if the fraction is $9\frac{1}{5}$, students had to cut a paper strip with the length 9.2 cm.

B. Using hands-on experience in developing the concept of division of fractions

In the lessons, students used either paper strips or Mathigon applet to solve problems involving division of fractions. They had to cut the paper strips or drag the correct fraction bars in the Mathigon applet to solve the problem. It provided learners with an alternative experience in solving problems involving division of fractions and later relates the calculation steps to solve other division of fractions problems.
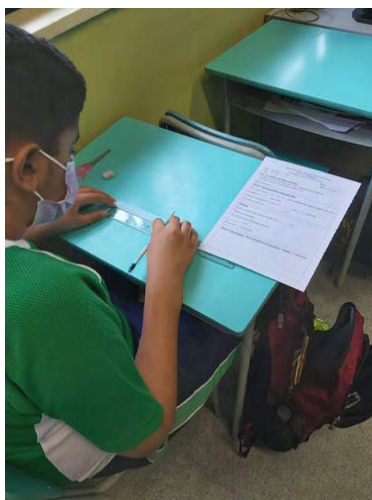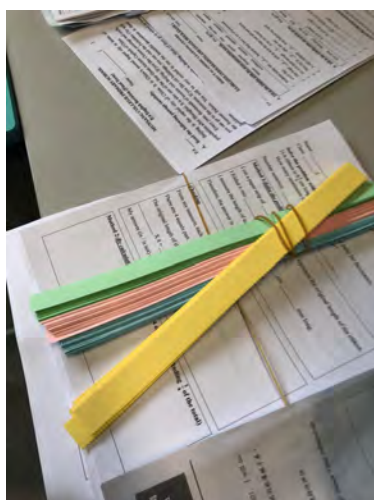
C. Peer learning

In these activities, teachers invited students to work in pairs. In the design of the lesson worksheets, teachers set different questions of similar levels of difficulty. After the student had finished his/her task, he/she had to check their peer's work. This provided opportunities for students to learn from peers and conduct peer assessment. Sometimes, a student might not understand what their partner had written and thus they sought clarification through discussion. This largely facilitated peer interaction among the learners.

D. Students creating flipped videos

Students also learnt how to use different IT tools to record videos. Teachers asked students to record short videos to show how they solved those problems with Mathigon, paper strips and calculation. The completed videos were saved on Padlet. This was totally voluntary. The videos can serve as flipped videos that students in the upcoming cohorts can watch while tackling problems involving division of fractions. It can showcase what students have learnt in different domains. It also gives students a sense of agency and ownership in learning. Please visit the resource page for the example videos created by students.

Using Paper Strips

Using Mathigon Applet – Polypad (Fraction Bars)

https://mathigon.org/polypad

QTN-T Project: Catering for Culturally and Linguistically Diverse Learners in Primary Mathematics Classrooms (2020-21)

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APPENDIX

Explanation on the paper strips task

A ribbon is $9\frac{1}{5}$ cm long. Peter cuts it into 4 equal parts for decoration. How long (in centimetre) is each part of the ribbon now?

Before the lesson, students learnt how to convert fractions into decimals and decimals into fractions. They could convert $9\frac{1}{5}$ cm into 9.2 cm. Cutting a paper strip of 9.2 cm into 4 equal part is more meaningful to a student than dividing $9\frac{1}{5}$ by 4. By doing hands-on paper strip cutting, students could divide a paper strip into 4 equal parts. This concretized the meaning of 9.2 cm ÷ 4 = 2.3 cm.

After doing all these hands-on activities, teachers taught students how to calculate $9\frac{1}{5}$ ÷ 4, which was an abstract number calculation that might only require procedural knowledge. $9\frac{1}{5} \div 4 = \frac{46}{5} \div 4 = \frac{46}{5} \times \frac{1}{4} = \frac{23}{10} = 2\frac{3}{10}$.

The answer means 4 pieces of 2.3 cm ribbon can be obtained by cutting a $9\frac{1}{5}$ cm ribbon into 4 equal parts.

Explanation of the Mathigon task

For example, '2 kg of sugar are divided into bags of $\frac{1}{5}$ kg. How many bags of sugar are there?'

Students used the fraction bar $\frac{1}{1}$ to represent 1 kg of sugar. They dragged two $\frac{1}{1}$ fraction bars to represent 2 kg of sugar. They also used the fraction bar $\frac{1}{5}$ to represent a bag of $\frac{1}{5}$ kg of sugar. By matching a number of $\frac{1}{5}$ fraction bars with two $\frac{1}{1}$ fraction bars, students could visually equate ten $\frac{1}{5}$ fraction bars with two $\frac{1}{1}$ fraction bars. Students could easily connect the fraction bars to the context in the questions. Thus, students could obtain the answer without doing any calculation.

Sample student work

In the figure below, the student could obtain the answer 12 from the Mathigon applet. However, the student could not draw the fraction bars accurately as the student could not keep the same length of the fraction bars.

Sample Student work (Using Mathigon applet)

In the figure below, the student could obtain the answer 12 from the Mathigon applet. However, the student could not draw the fraction bars accurately as the student could not keep the same length of the fraction bars.

Learning from mistakes

Learners always make mistakes in the process of learning something new. As shown in the figure below, students made mistakes in representing the fraction bars with a correct length. When students recognised this from getting different answers from peers, they would try to come up with a correct answer. In this case, peer learning took place with self-assessment, peer assessment and discussion. In the meantime, teachers played the role of a facilitator who encouraged peer discussion and equipped students with the essential skills and tools to verify their answers.