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One way that teachers teach for mathematical understanding is by building up skills and deeper concepts so that students can connect new ideas to what they already understand. We suggest beginning with a variety of DI strategies that are challenging, yet not threatening. For this to work efficiently, teachers must know their students and provide them with a nurturing environment. As teachers differentiate instruction, it becomes easier to actively build student knowledge, interaction and problem solving on a daily basis. Another common feature of a differentiated classroom is that learners are often asked to act with initiative and purpose in determining how they go about doing their work. Effective teachers make sure everyone knows there isn't just one way of thinking about problems. By encouraging students to consider a variety of approaches and solutions, it is easier for them to view problems in more of a real-world context.

Differentiating the Learning of Mathematics

There are several ways teachers can differentiate or modify instruction in the maths classroom. As we pointed out in Chapter 1 explaining content, connecting with students' interests, tapping into students' learning profiles, and providing a differentiated learning environment are important for effective maths instruction.

Many people have their own ideas of what mathematics is. Which of the following views of mathematics is closest to yours? Here, we offer a few views and give some suggestions of how to apply them.

Mathematics Is a Way of Thinking and Asking Questions

Student Actions

1. List all the times outside of school where you used maths this week.
2. How often did you use maths today: looking at the clock, lining up in the supermarket checkout queue, buying lunch, for example?

Mathematics Is a Knowledge of Patterns and Relationships

Student Actions

1. Show how one maths combination (like $4 + 2 = 6$) is related to another basic fact (like $6 \div 4 = 2$).
2. Advanced thinkers: Show how multiplication and division are interrelated ($4 \times 3 = 12$ and $12 \div 3 = 4$). Have them use their observation skills to describe, classify, compare, measure and solve problems.
3. The advanced thinker can explain the maths relationships the class has discovered by inventing a scary mystery problem either by using addition, subtraction, multiplication or division.

Maths Is a Tool That We Use Every Day

Student Actions

1. Solve this problem using the tools of mathematics. A man bought an old car for \$50 and sold it for \$60. Then, he bought the car back for \$70 and sold it again for \$80. How much money did he make or lose?
2. Do the problem with your group and explain your reasoning.

Gearing Down

- Have students use play money and act it out.

Gearing Up

- Try the problem again using a different strategy.

Maths Is Having Fun

It's similar to solving a puzzle. Maths video games are exciting challenges for many primary and middle years students, such as Maths Blaster and Maths Commander.

Student Actions

1. Play a maths video game with your group.

Gearing Up

- Explain the video game.
- Compare the game with another maths game.
- How are they alike or different?

Gearing Down

- Share something about the video game. What did you like?

2. With a partner, play a game of cribbage (a card game in which the object is to form combinations for points).

Gearing Up

- Keep track of your points.

Gearing Down

- Play a game of maths bingo:

The teacher calls out a number from zero to five.

The students place that many markers on a bingo card.

Then, the teacher calls out another number and the students place that many additional markers on their board.

The students check their bingo cards for the total number.

Maths Is an Art

Student Actions

- With a small group of students, design a picture.

Gearing Down

- Have students find shapes and label them.

Gearing Up

- Create a mystery or futuristic art picture using geometric shapes.
- Label the shapes.

Maths Is a Specialised Language

It uses special terms and symbols to represent information.

Student Actions

1. Brainstorm about favourite hobbies, television programs, kinds of pets or favourite video games. Share with your group.
2. Once a topic is agreed on, organise and take a survey of all class members. When the data are gathered and compiled, have groups make a clear, descriptive graph that can be posted in the classroom.

Gearing Down

- Form a good question, such as, “What kind of pet do you own?”

Gearing Up

- Investigate the question, asking questions such as, “Why do most people in class own a cat or a dog?” Explain your reasoning.

Maths Is Interdisciplinary

Gearing Down

- With a group, design a song using rhythmic format that can be sung, chanted or rapped.

Gearing Up

- The lyrics can be written and musical notation added.

Guidelines for Differentiating Maths Instruction

- *Less is better.* Students who are having difficulties with maths problems perform better if they have fewer problems to solve. A smaller number of problems that are similar let students develop a deep understanding of how to arrive at a solution.
- *Describe information at three levels.* Maths concepts can be presented at three levels: (1) concrete (using manipulatives), (2) pictorial (using pictures) and (3) abstract (when you use numerals, symbols, or variables).
- *Focus on maths patterns.* Patterns such as counting by twos, threes, fives and tens can help students with simple multiplication maths facts. Patterns can be used as helpful steps in finding solutions to problems. You can emphasise maths patterns that use movement as classroom games at various points during the day.
- *Use creative methods to teach basic facts.* Teaching maths combinations through the use of songs, rhythms and other novel teaching techniques improves students' memory for learning basic maths combinations. These techniques are entertaining for students and help students who learn better using their strength in musical intelligence.
- *Structure a lesson that focuses on students' strengths.* Use a number of intelligences to present the maths information. For example, you may create a movement activity to practise maths facts. Teachers often find new ways to represent the maths combinations with bodily movements (touching your head, shaking your finger, stamping your feet and so on). Such innovation improves the students' learning and provides better retention.
- *Use genuine situations.* Teachers often use real-world examples and make associations between students' previous knowledge and new information using actual situations. These kinds of activities motivate students to learn maths as well as improve interpersonal relationships.
- *Recognise students' maths fear.* Too many students fear mathematics because they remember their early maths failures. Teachers can have students work in pairs or small groups to share their experiences and arrive at solutions together.

Algebra

Lesson Plan 6: Algebra Forehead Poker

With Kris Berry

Topic: Algebra

Year level: 2 and up

Objectives

The game of brow or forehead poker is designed to reinforce and teach missing number problems in algebra.

Examples of missing number operations:

$$3 \text{ plus } \underline{\quad} = 10 \text{ answer} = 7$$

$$4 \text{ times } \underline{\quad} = 32 \text{ answer} = 8$$

Materials

- Deck of cards for each group
- Optional worksheets for written reinforcements of problems solved

Procedures

1. Students form groups of three. Two students are players, one is the judge.
2. Deck of cards is shuffled. Two students draw randomly and each holds a card on forehead face out, so they are unable to see their own card.
3. The judge announces the answer to the maths problem using numbers on both cards (for example operation given “we’re doing addition right now”).
4. As each player knows what the other card is, they are able to guess their own card by working out the maths problem.

Example

Jenny has a 7 against her forehead. Scott has a 4. The judge announces that the answer is 11. Scott can work out that because Jenny has a 7 he must have a 4. The first student to guess their own card wins.

Structure

- Introduce class to the missing number operations game.
- Model the game in front of class.
- Have students form groups.

Gearing Down

The game can be done with addition or subtraction.

Gearing Up

- Change the operation. The game can be done with multiplication and even equivalent fractions.
- Can you invent other ways to use it?

Assessment

- Students' understanding is checked by the work done in groups and with fellow students. Students collect the cards at the end of each match. The student with the greatest number of cards wins.
- Have students reflect on the game. What was exciting about it? Did it improve their performance?

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Orange Fruit Salad

2 oranges, 2 apples and 2 bananas

Cut up fruit and mix together in large bowl. The juice from the oranges help keep the apples from turning brown. Prepare just before serving.

Earth Science

Earth science resources are rocks and soils, water and gases of the atmosphere. The sun, moon, stars, clouds, birds and aeroplanes all have properties that can be observed and described.

Lesson Plan 12: Gases Everywhere

Adapted from American Chemical Society, 2001; with Andrea Eng

Topic: Gas pressure

Year level: 3–5

Materials

- Litre-sized zip closing plastic freezer bags
- Plastic flexible straws
- Books
- Beach ball

Objectives

Students know what gas pressure is. Students understand the relationship between gas and pressure (adding gas increases pressure, removing gas decreases pressure).

Introduction

1. Hold up a beach ball and have a few volunteers come squeeze the ball. Ask them if it was easy or hard to squeeze?
2. Now, let a little air out and have them squeeze the ball again. Is it easier or harder to squeeze?
3. Explain what pressure is (a force exerted by a substance on another substance).
4. Explain what gas pressure is (the pressure of a gas is the force that the gas exerts on the walls of its container). As the pressure increases, the gas pushes harder and harder against the inside of the container.

Model/Procedures

Pass out plastic bags and straws. Have students follow along as the teacher demonstrates the activity.

1. Place the plastic bag near the edge of the table. Close the bag except for a small spot in the corner.
2. Put a straw into the bag with part of the flexible straw sticking out. Use your fingers to press down on both sides of the straw to keep the air from leaking out of the bag. Blow into the bag.
3. When the bag looks like a little pillow, take the straw out and seal the bag. What do you feel? Push down on the bag, the air pressure is pushing up on your hand.
4. *Put this pressure to work.* Let the air out of the bag and put the straw into the bag. Place a book on top of the bag.

Gearing Down

- Blow into the bag. What happens to the book?
- Try lifting two books. How many books do you think you can lift with the power of pressure? Try it and see! Record what happened in your science journal.

Gearing Up

Some real life examples include air bags found in most cars. The activity shows students how an air bag works.

- Can you think of other real life examples of air pressure?
- Explain why an air bag offers better protection for the driver or an air tank assists scuba divers.

Assessment

Create an observation chart on gas pressure. Record guesses of how many books you can lift and actual amounts. Put your work in your portfolio.

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