

INSTITUTE OF EDUCATION

An Associated College of Trinity College Dublin, the University of Dublin

CATERING FOR A WIDE RANGE OF LEVELS IN THE MATHS CLASSROOM: A PRIMARY TEACHING PERSPECTIVE

SEÁN DELANEY





INTRODUCTION

- My background
- What is similar about your situation?
- What is different about your situation?
- What idea(s), principle(s), strategy(ies) could you use?
- What idea(s), principle(s), strategy(ies) could you adapt?





Kettlebell Goblet Squat







Kettlebell Military Press







Kettlebell Deadlift Sumo High Pull







Kettlebell Swing







Kettlebell Deadlift Sumo High Pull













TEACHING MATHEMATICS IN PRIMARY SCHOOL

Today

- Increasingly diverse student body
- Students with special needs
- Streaming/tracking/'ability' grouping ineffective or impractical
- Students at different stages of readiness



BROAD MODELS OF DIFFERENTIATION

US Approach	Japanese Approach
Individual	Whole-class approach
Assess children, tailor instruction for individual children or for small groups of children	View intrinsic differences among children as a resource for approaching tasks
Different strategies used for teaching different children	Explain ideas in multiple ways to all children and help all children clarify and reconcile ideas and approaches
Individual differences are an obstacle to effective teaching	All students benefit from the variety of ideas generated by their peers
Meeting each student's needs means providing different instruction for children's different levels of achievement to date	Tailoring instruction to specific students is unfairly limiting and prejudges what children are able to learn



SPECIFIC EXAMPLE

Teaching fractions to children in 5th/6th class

If I eat 1 $\frac{1}{2}$ bars of the 3 $\frac{4}{5}$ bars of chocolate I bought earlier, how many bars of chocolate have I left?

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POSSIBLE WAYS OF DIFFERENTIATING

If I eat 1 ½ bars of the 3 4/5 bars of chocolate I bought earlier, how many bars of chocolate have I left?

- Change the order in which the numbers are written
- Include a picture alongside the problem
- Change from a word problem to a problem with symbols only
- 3 1 (Remove the fractions)
- 3 4/5 1 (Remove the fraction from the subtrahend)
- 3 4/5 1 1/5 (Change the fraction in the subtrahend so that it has the same denominator as the fraction in the minuend)
- 19/5 3/2 (Write both fractions as improper fractions)
- 4/5 ½ (Remove both whole numbers so that only the fraction parts need to be subtracted)
- 4/5 1/5 (Remove both whole numbers and use the same denominator in both fractions)
- Other ideas?



ECOME THE

<mark>A GUIDE TO CAREER SUCCESS</mark> SEÁN DELANEY

A David Fulton Back

WHOLE CLASS DIFFERENTIATION THROUGH DISCUSSION





SELECT TASKS THAT CAN BE ACCESSED BY STUDENTS AT DIFFERENT LEVELS OF ACHIEVEMENT



Solve this problem with a partner.

Dublin Zoo has just received two new sheep for the Family Farm part of the zoo. The zoo keeper wants to build an enclosure for the sheep. She decides that the enclosure must be square or rectangular with an area of exactly 100 square metres.

- (i) Which different enclosures could she build?
- (ii) How many metres of fencing will she need for each possible enclosure?
- (iii) Use your copy or some graph paper to draw all the possible rectangular or square enclosures.
- (iv) Include a key to tell how much each unit on your copy or graph paper equals.
- (v) Which enclosure would you recommend that the zoo keeper builds? Why?





Swimming Calculations

- What is the length of our local swimming pool?
- If I swam the following number of lengths, how far would I have swum?

1 length	The numbers you choose here allow you to
2 lengths	differentiate among learners in the class. Some
Multiplying ^{lgths}	children will do them all and more complicated
ionengths	ones. Others will just do some of these. Try to
50 lengths	help each child do better than they think they
½ length	can do.
Say how you figured out each one.	
•If the pool is 25 metres long, how many lengths would I have to swim in order to swim 50 metres	
Dividing ¹⁰⁰ metres?	
250 metres?	
500 metres?	
a kilometre?	
5 metres?	
Say how you figured out each one.	





DISCUSS A TASK IN GREAT DETAIL

- What do we know?
- What information is most/least important do you think?
- What do we need to find out?
- How can we find that out?
- Where could we start?
- Are there other ways to do it?



ENCOURAGE PAIRS OF STUDENTS TO HELP EACH OTHER

• Both have to be able to explain how they got the answer





TARGET QUESTIONS TO STRETCH ALL STUDENTS

- Plan the questions you'll ask
- Which ones are more/less difficult?
- To whom will you direct the different questions?



DISCUSS TOPICS THAT ARE ADVANCED FOR A PARTICULAR CLASS LEVEL



DISCUSS TOPICS THAT INVOLVE REVISION OF WORK DONE PREVIOUSLY

- Some fundamental topics in mathematics
- Place value
- Equivalence
- Mathematical operations
- Common misconceptions (multiplying always implies getting bigger/dividing always implies getting smaller etc.)





SEEK A WRONG ANSWER TO SURFACE POTENTIAL CONFUSION

- Errors are an important resource
- Thank students for raising the mistake
- Why is it a mistake?
- How can members of this class avoid making such a mistake in the future?





REVOICING (AND RELATED STRATEGIES)

Discuss conjectures & solutions in great detail – correct and incorrect

- Are you saying that....
- I think you're saying that..... Am I right?
- Can you repeat what ... said?
- You said X but someone else said Y. How would you respond to the other person?
- Can you put what ... said into your own words?
- Do you agree or disagree with what ... did?



RECORD QUESTIONS, IDEAS AND CONFUSIONS IN STUDENTS' NOTEBOOKS

- Record one thing you learned today
- Note one thing you're confused about
- Write down a question you have
- What you think about the discussion we had about?
- How would you explain to someone who is learning it for the first time?
- What would you like to work on next?



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VIDEO

- Mathematics Laboratory class
- 20 children in 5th class (age 11)
- Recruited from 11 different schools (4 serving areas of disadvantage)
- Goal of lesson: Children apply their knowledge of area and perimeter to solve a multi-step problem
- After school on a Friday afternoon/Saturday in May
- Goal of professional development model is not to offer model teaching but public teaching
- Observed by 20 educators
- Amplified and video recorded
- 2 girls have just shared their solutions 25m x 4m and 50m x 2m www.mie.ie
- 13'20 +



WORKING ON THE SAME PROBLEM, EACH AT THEIR OWN LEVEL





YOUR SITUATION V PRIMARY TEACHING

- Mathematics problems you use will be different
- Adults may be reluctant to criticise peers/share answers
- Need to create a safe space
- Need to deliberately work to create classroom norms so that everyone present sees themselves as a resource for everyone else's learning – and that includes being willing to make mistakes in public



UNIVERSAL DESIGN FOR LEARNING

Universal Design for Learning

- Multiple means of engagement
- Multiple means of representation
- Multiple means of action and expression



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Universal Design for Learning Guidelines

II. Provide Multiple Means of I. Provide Multiple Means of III. Provide Multiple Means of Action and Expression Representation Engagement 1: Provide options for perception 4: Provide options for physical action 7: Provide options for recruiting interest 1.1 Offer ways of customizing the display of information 4.1 Vary the methods for response and navigation 7.1 Optimize individual choice and autonomy 1.2 Offer alternatives for auditory information 4.2 Optimize access to tools and assistive technologies 7.2 Optimize relevance, value, and authenticity 1.3 Offer alternatives for visual information 7.3 Minimize threats and distractions 5: Provide options for expression and communication 8: Provide options for sustaining effort and persistence 2: Provide options for language, mathematical expressions, and symbols 8.1 Heighten salience of goals and objectives 5.1 Use multiple media for communication 2.1 Clarify vocabulary and symbols 8.2 Vary demands and resources to optimize challenge 5.2 Use multiple tools for construction and composition 2.2 Clarify syntax and structure 8.3 Foster collaboration and community 5.3 Build fluencies with graduated levels of support for 2.3 Support decoding of text, mathematical notation, practice and performance 8.4 Increase mastery-oriented feedback and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media 9: Provide options for self-regulation 3: Provide options for comprehension 6: Provide options for executive functions 9.1 Promote expectations and beliefs that optimize 3.1 Activate or supply background knowledge 6.1 Guide appropriate goal-setting motivation 3.2. Highlight patterns, critical features, big ideas, and 6.2 Support planning and strategy development 9.2 Facilitate personal coping skills and strategies relationships 6.3 Facilitate managing information and resources 9.3 Develop self-assessment and reflection 3.3 Guide information processing, visualization, and 6.4 Enhance capacity for monitoring progress manipulation

Strategic, goal-directed learners

Purposeful, motivated learners

CAST

3.4 Maximize transfer and generalization

Resourceful, knowledgeable learners

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PICTURE CREDITS

- <u>http://www.over60health.info/health-</u> <u>articles/exercise-fitness/kettlebell-and-kettlebell-</u> <u>workouts/</u>
- <u>https://www.abcallenamento.it/allenamento-</u> <u>funzionale/esercizi-fisici-functional-training/stacco-</u> <u>sumo-con-kettlebell.html</u>
- <u>http://www.alarisfitness.com/an-ode-to-the-proper-kettlebell-swing/</u>
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