The numeracy process : How numeracy ideas are learnt

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What we do to learn maths ideas ?

A lesson in gimming

Look at these instances of gimming. What does gimming do ?
4 gim 3 = 10 5 gim 3 = 13 6 gim 3 = 16

What does gimming do? . Work out the value of
7 gim 3 = 8 gim 3 = 11 gim 3 =

Often when we learn an idea we need to modify our first impressions. What we thought was being done may not explain fully all parts of the idea. Here are more examples of gimming:
4 gim 2 = 7 5 gim 2 = 9

Work through the exercises below:
4 gim 7 = 5 gim 4 = 9 gim 8 =

Corrective feedback: 4 gim 7 = 22 , 5 gim 4 = 17, 9 gim 8 = 65.

Types of maths knowledge students are expected to learn

Across all of the content areas of maths, maths curricula usually require students to learn

- ***conceptual knowledge***; that is, what ideas mean, knowing 'when to' and 'why', 'what' two or more ideas share, recognising examples of an idea,
- ***actions or procedures***; algorithms, procedural knowledge, knowing 'how to do' things in mathematics, for example, subtract by decomposing, use a calculator to add count down,
- ***mathematical relationships*** , relating ideas, eg, ordinal, equality and inequality,
- ***language of maths;*** talk, read, write, use maths vocabulary and the symbolism of maths,
- ***automatized factual knowledge*** , for example, recall the four times table, subtraction 'facts'. Information recalled automatically demands less mental attention.
- ***how to learn maths***; the actions they use to learn maths There are two types of actions: ways of thinking about maths ideas, for example
  - draw pictures of mathematical ideas, visualise an idea
  - talk about ideas they are learning,
  - ask *What does this remind me of ?* This helps them link with what they know.

  ways of managing their maths learning, for example, they
  - plan their way through maths tasks.

- decide if solution is reasonable.

These are their metacognitive strategies. They use self-talk to do this.

- ***problem-solving strategies*** in maths; ways of thinking about mathematical ideas,
- ***their beliefs and attitudes*** about learning maths. Students learn three types of attitudes
  - *what maths is like* : dull and boring, vs interesting, challenging, abstract, removed from the real world vs useful for solving real-life problems.
  - *how maths is learnt* - you must avoid making errors vs errors help you learn you mustn't guess or take risks vs risk-taking and guessing important in learning.
  - *themselves as maths learners*- I could never learn maths vs I find it hard but I can learn it.

Examples of each type of outcome for place value for higher numbers and for instances of common fractions are shown below:

Type of outcome	Examples	Types of difficulty
concepts	• recognise numbers that had a digit in the ten-thousands place • recognise real-life instances of a common fraction such as "two fifths".	• transferring idea to other contexts, other numbers • categorising simple fractional quantities
maths actions	• add two 5-digit numbers • convert a fractional quantity to a symbolic form	• recalling how to apply action to unfamiliar tasks • representing both the numerator and denominator correctly
maths facts	• recall the addition of numbers to 20 • recall the multiplication facts	• recalling facts automatically, work them out laboriously
attitudes to maths	• explain why learning about 5- and 6- place numbers is useful • use trial and error spontaneously in maths	• anxious when learning maths • not prepared to take risks
ways of learning maths	• say 5-digit numbers to learn to identify each place • visualise common fraction such as "two fifths"	• tries to learn maths in a passive way • doesn't use encoding strategies
maths language symbols	• write in numbers a spoken number with places up to one hundred thousand • writes a fractional quantity in symbols	• recalling how to use the symbolism

In a group, from your experience suggest examples of difficulty in each of learning outcomes. Also, suggest a teaching procedure you could use to remediate it.

Types of difficulty	Examples	Suggested remediation
concepts		
maths actions		
maths facts		
attitudes to maths		
ways of learning maths		
maths language symbols		

The dynamics of maths learning Individuals learn in different ways. The following metaphor explains individual differences in learning at any time : learners

- have sites where they change what they know; thinking space or short term working memory.

- differ in how they link ideas to make sense of them; they have several codes for doing this.
  - verbal code; think by using words, sentences and verbal propositions.
  - scientific/maths code; use abstract concepts and symbols ($A=1/2\pi r^{2)}$, to understand.
  - episodic/ imagery code; understand by imagining ideas.
  - action code; understand by using actions for ideas.
  - rhythmic code; knowing by using rhythm.
  - affective / mood code; knowing using affect, emotional feeling or mood.

- differ in how easily they spontaneously and selectively use these codes.

- 'move' ideas between codes using a recoding process.

- handle a limited amount of data used at any time.

- differ in how they act on or manipulate the ideas in each code. Learners can use either

- sequential-analytic strategies; analyse ideas into parts and sequence them
- wholistic-synthetic strategies integrate ideas with other ideas, treat each as a whole.

  Most learners use these strategies selectively

- monitor and direct their learning; this may include

  - using alternative codes and data-processing strategies during learning
  - planning how they will learn, (the codes and manipulative operation/s they will use),
  - monitoring how successfully their learning is progressing (for example, to switch between alternative codes when learning an idea is difficult) and
  - reviewing their change in knowledge about themselves as learners.

When they have difficulty learning in one code they can change to a different code..

Briefly suggest some behavioural difficulties students would show if they had difficulties in any of the areas above:

Area of maths processing	Indicative behaviours	Possible remediation steps
restricted thinking /learning space or short term working memory for dealing with maths ideas		
Overly rely on imagery to learn maths ideas		
Overly rely on actions to learn maths ideas		
Overly rely on rhythms actions to learn maths ideas		
Have difficulty 'moving' ideas from one learning code to another		
Overly use wholistic-synthetic thinking strategies for learning maths		
Difficulty monitoring and directing their learning		
Difficulty planning how they will do maths tasks		
Difficulty monitoring how successfully their learning is progressing		
Difficulty reviewing how their learning		