TRENDS IN MATHEMATICS TEACHING

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Pedagogy, like language itself, can either liberate or imprison ideas, inspire of suffocate constructive thinking.
- **Hyman Bass**, *from "Mathematicians as Educators"*

Chocolate bars sharing

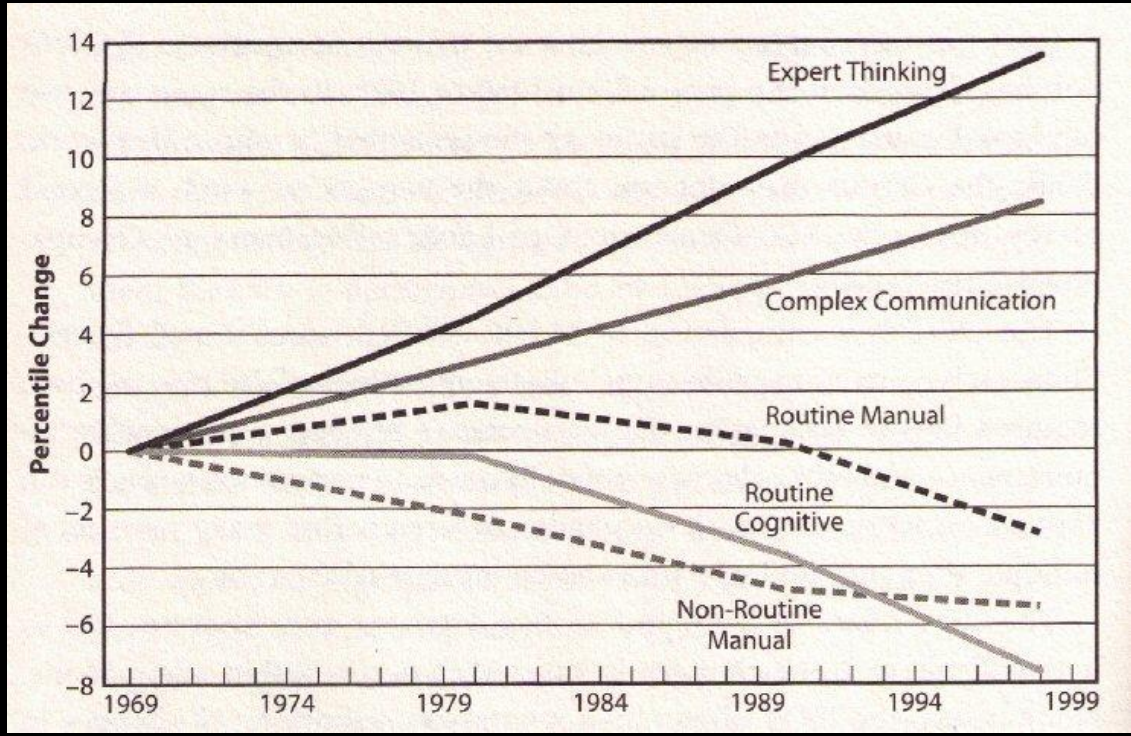
Iwan Pranoto 2010

Murnane-Levy

Expert thinking: solving problems for which there are no rule-based solutions, such as diagnosing the illness of a patient whose symptoms seem strange

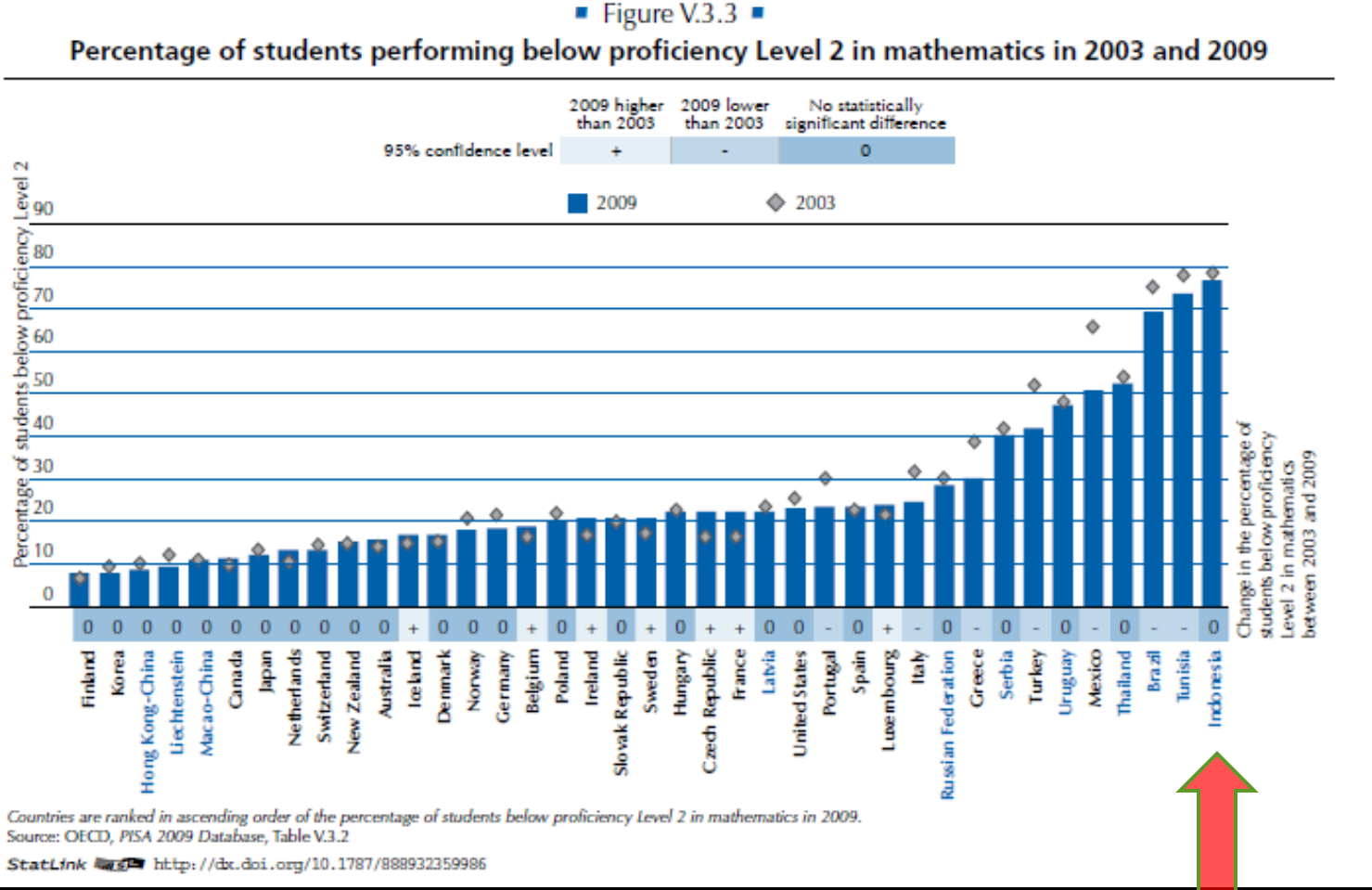
Complex communication: interacting with others to acquire information, to explain it, or to persuade others of its implications for action; for example, a manager motivating the people whose work she supervises

Routine cognitive tasks: mental tasks that are well described by logical rules, such as maintaining expense reports



if students learn merely to memorise and reproduce scientific knowledge and skills, they risk being prepared mainly for jobs that are disappearing from labour markets in many countries.

Percentage of students performing below proficiency Level 2 in mathematics in 2003 and 2009

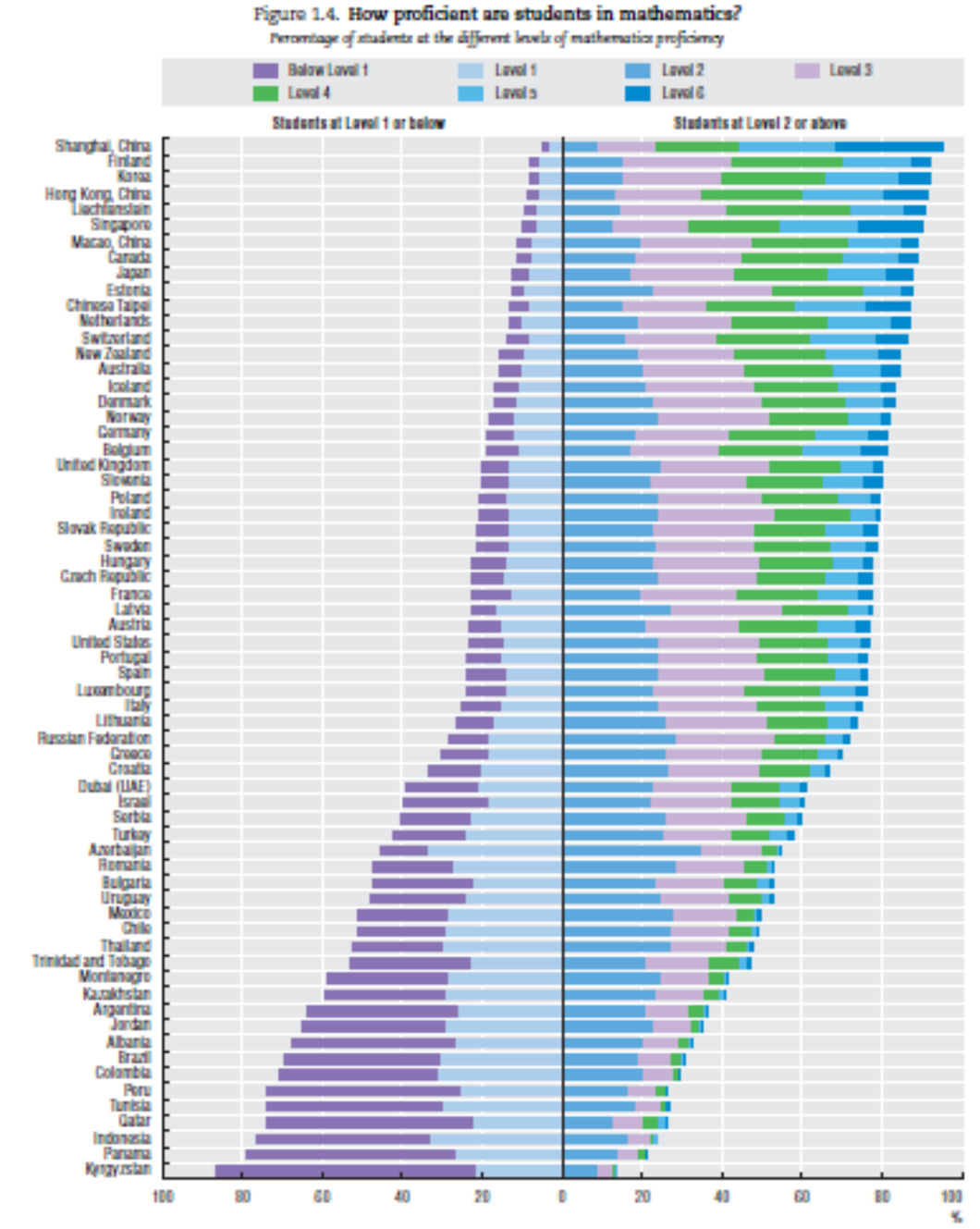


Di sini, tampak bahwa siswa Indonesia dengan profisiensi di bawah level 2 sangat tinggi, mencapai 76,6% dari populasi. Juga tampak sejak 2003, kondisinya hampir tidak berubah (lambang 0). Situasi ini menunjukkan pendidikan matematika yang sekarang tidak mampu mengangkat ke level 2 atau lebih atas. Pembenahan pendidikan matematika sekolah kita belum berhasil.

Seberapa profisien siswa Indonesia dalam matematika?

Dari penyajian grafik di samping, yang harus diperhatikan bukan posisi Indonesia yang di posisi 3 dari bawah. Yang justru merisaukan adalah dua fakta: Persentase siswa Indonesia yang di bawah level 2 sangat besar 76,6% dan persentase siswa yang di level 4, 5, dan 6 secara statistika tidak ada.

Menurut pendefinisian level profisiensi matematika dari OECD, siswa di bawah level 2 dianggap tidak akan mampu berfungsi efektif di kehidupan abad 21.



Note: Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.

Source: OECD (2010), PISA 2009 Results, Volume I, What Students Know and Can Do: Student Performance in Reading, Mathematics and Science, Figure 1.3.9, available at http://dx.doi.org/10.1787/888932343152.

Summary descriptions for the six levels of proficiency in mathematics

Level	Lower score limit	What students can typically do
6	669	At Level 6 students can conceptualise, generalise and utilise information based on their investigations and modelling of complex problem situations. They can link different information sources and representations and flexibly translate between them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situations.
5	607	At Level 5 students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare, and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriately linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning.
4	545	At Level 4 students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. Students at this level can utilise well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	482	At Level 3 students can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications reporting their interpretations, results and reasoning.
2	420	At Level 2 students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and literal interpretations of the results.
1	358	At Level 1 students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.

MATHEMATICS EXAMPLE 1: HEARTBEAT

Untuk alasan kesehatan, manusia harus membatasi kegiatannya, seperti misalnya saat olah raga, agar detak jantungnya tidak melebihi frekwensi tertentu. Sudah bertahun-tahun hubungan antara detak jantung maksimum yang dianjurkan dengan usia dijabarkan dengan rumus berikut:

Detak jantung maksimum yang dianjurkan = 220 – usia

Sebuah riset terakhir menunjukkan bahwa rumus tersebut perlu sedikit diubah. Rumus baru itu sebagai berikut:

Detak jantung maksimum yang dianjurkan = 208 – (0.7 × usia)

Question 1

Sebuah artikel di koran menyatakan: “Akibat penggunaan rumus baru dibanding rumus lama adalah jumlah detak jantung per menit yang dianjurkan untuk manusia muda sedikit menurun dan untuk orang tua naik sedikit.”

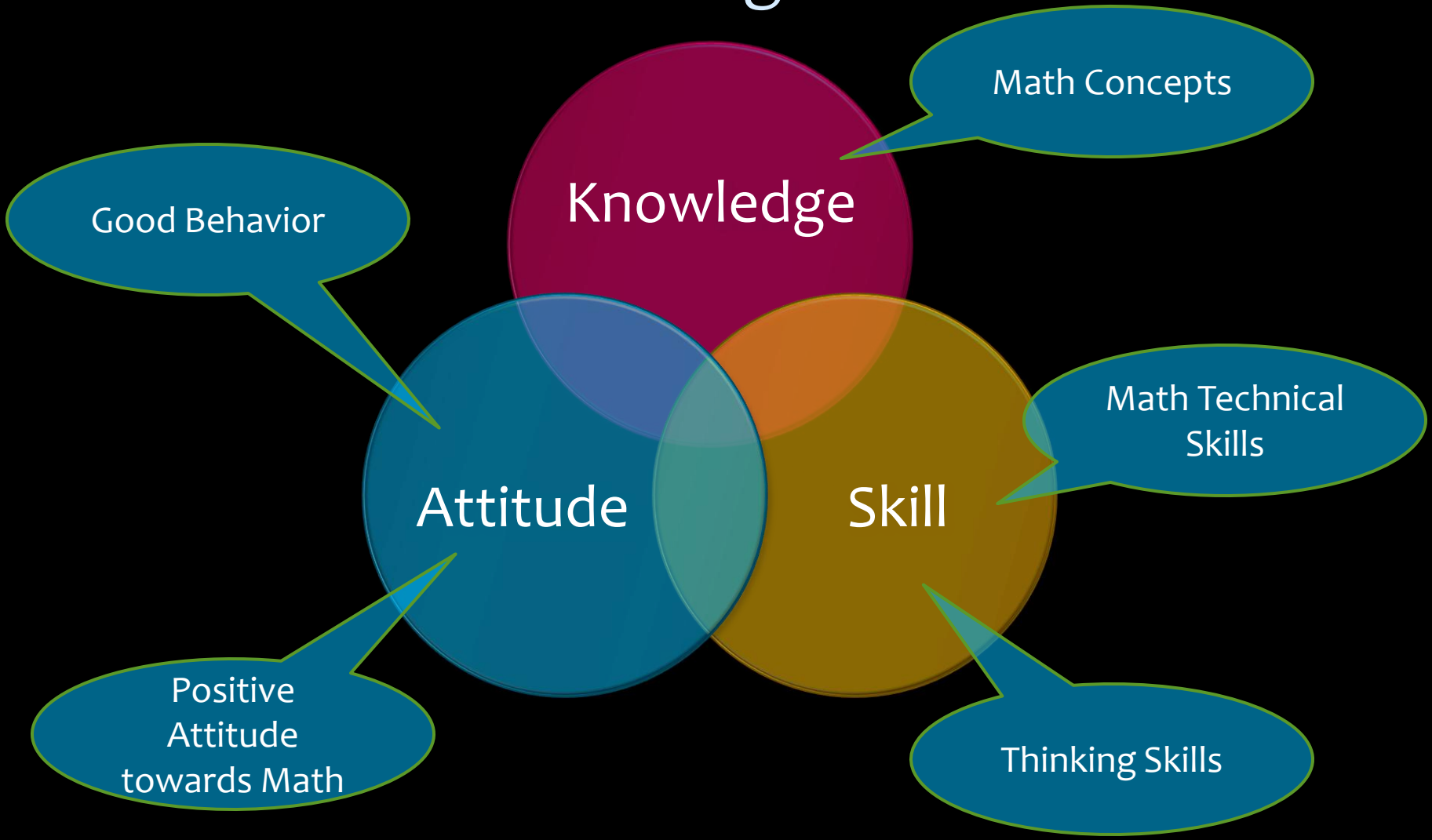
Dari usia berapa, detak jantung maksimum yang dianjurkan meningkat disebabkan oleh penggunaan rumus baru? Tuliskan cara kamu memperoleh jawab.

Mathematical Power

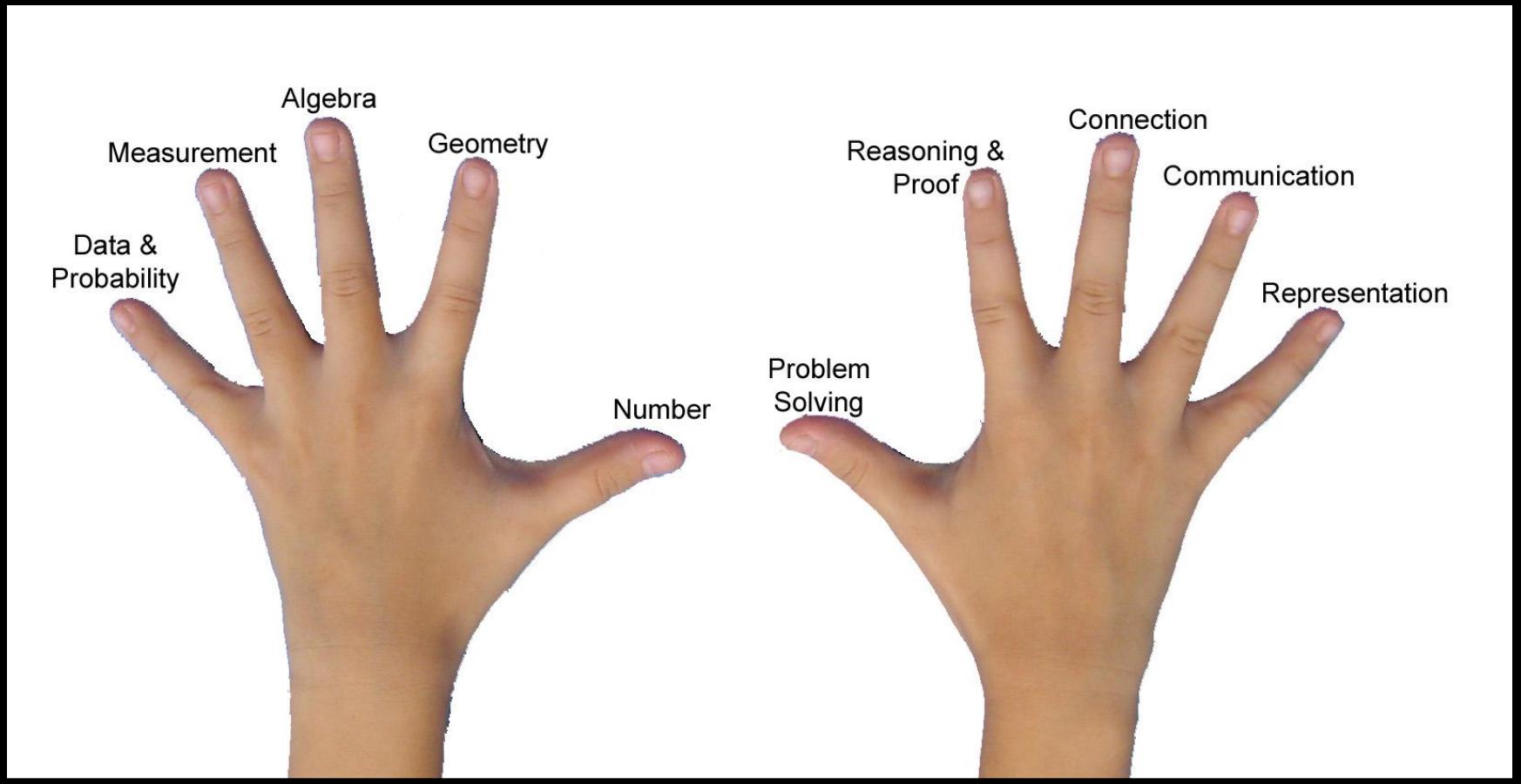
"Mathematical Power includes the ability to ***explore, conjecture, and reason logically****: to* ***solve nonroutine problems****; to* ***communicate about and through mathematics****; and to* ***connect*** *ideas within mathematics and between mathematics and other intellectual activity. Mathematical power also involves the development of* ***personal self-confidence*** *and a* ***disposition to seek, evaluate, and making decisions****. Students'* ***flexibility, perseverance, interest, curiosity, and inventiveness*** *also affect the realization of mathematical power. "*

(NCTM 1991)

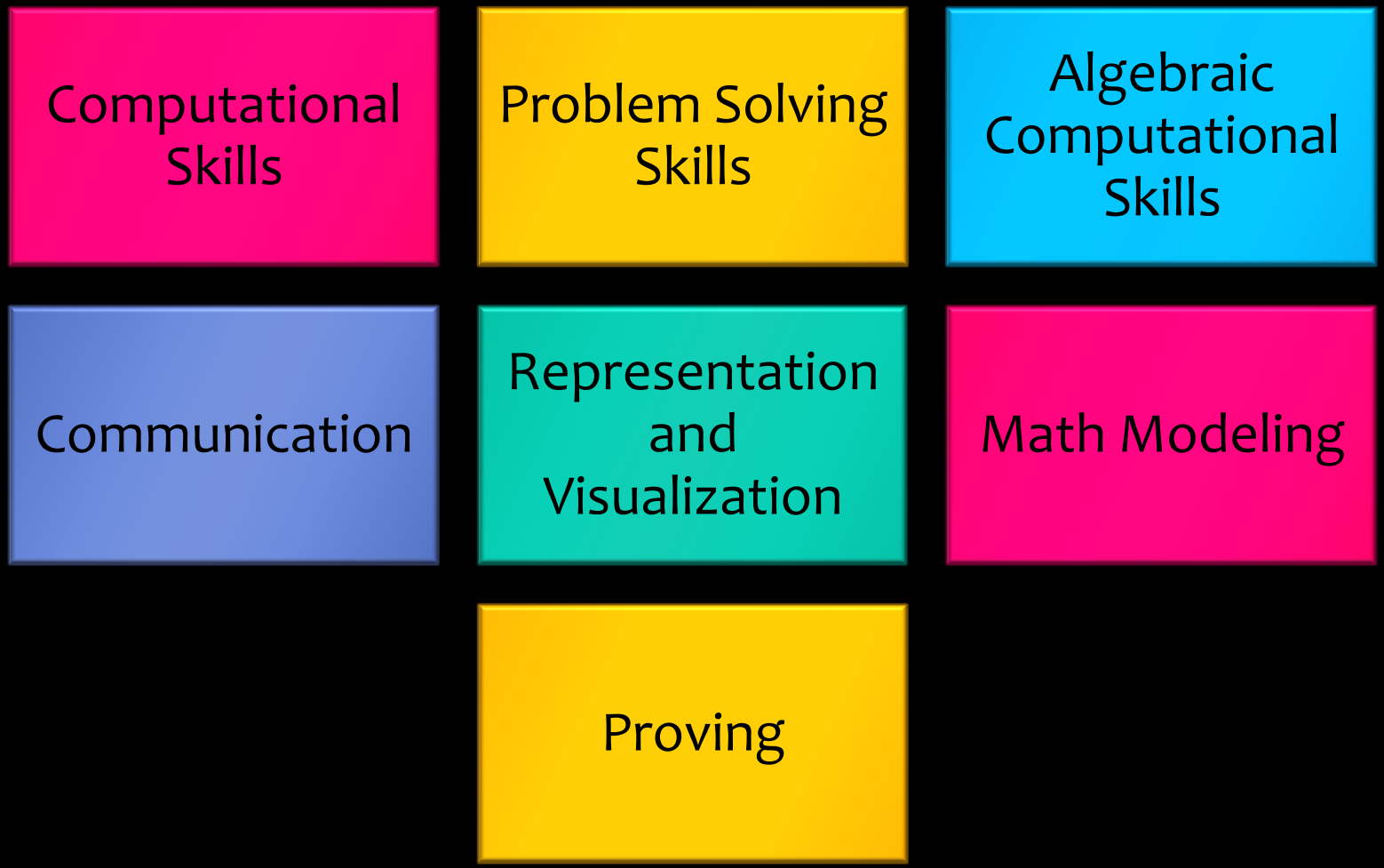
Areas to Nurture through Math



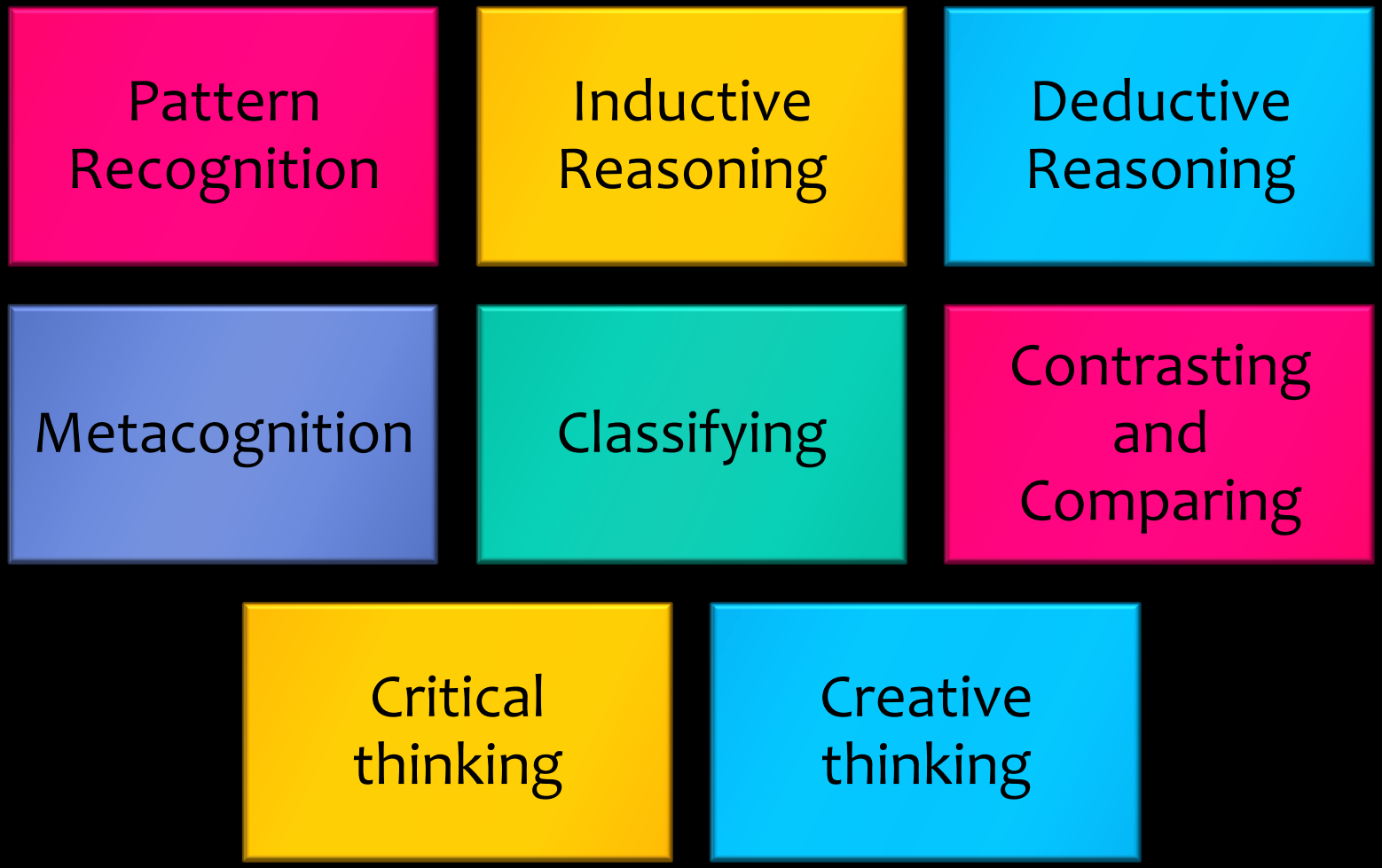
Standar Matematika Sekolah versi NCTM



Math Technical Skills



Thinking Skills



Positive Attitudes toward Math

Confidence in math

Enjoy to do math

Appreciate the function of math

Appreciate the beauty of math

Positive behavior

Gigih

Suka tantangan

Berani mencoba dan salah

Menghargai usaha sendiri

Terbuka dan menghargai pendapat orang lain

Trends in Math Teaching

Interactive and more visual discussion

Utilization of IT (calculator, PC, Internet)

Intrinsic Motivation through Challenge and Support

Learning responsibility, e.g. the utilization of choice

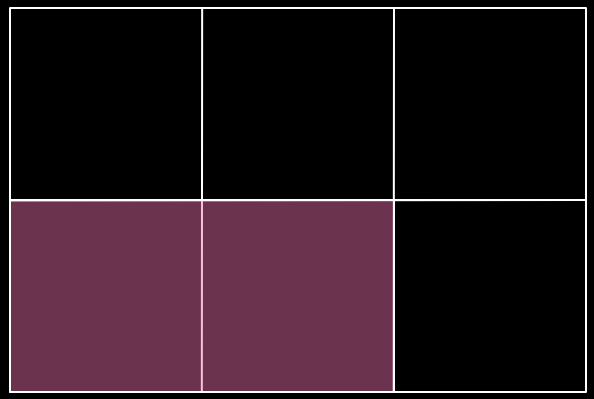
Problem solving

Video Pembelajaran

Interactive and more visual discussion

Gagasan-gagasan matematika banyak yang dapat divisualisasikan, untuk membuat siswa yakin bahwa matematika memang masuk akal, sehingga tak perlu dihafal.

- Facebook, YM, dsb
- Contoh visualisasi:
  - Perkalian pecahan dengan visualisasi luas persegipanjang, e.g. ½ × 2/3 = 2/6 = 1/3
  - Perkalian desimal dengan base-10 blocks, e.g. 0,3 × 0,7 = 0,21
  - Dsb.



My Pals are Here 5A Ilustrasi Visualisasi:

Perkalian pecahan dapat dimodelkan sebagai luas persegipanjang.

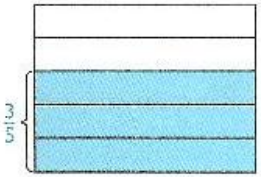
Pemaknaan perkalian pecahan ½ × 3/5 juga dapat ditafsirkan sebagai ½ bagian dari 3/5 bagian.

4 Fractions (2)

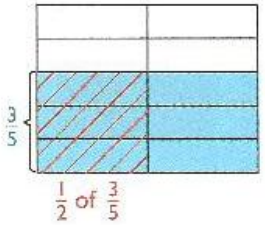
Let's Learn!

Product Of Proper Fractions

1 Margie draws a rectangle and colours $\frac{3}{5}$ of it blue.

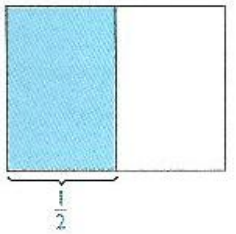


She then draws red stripes over $\frac{1}{2}$ of the coloured parts.

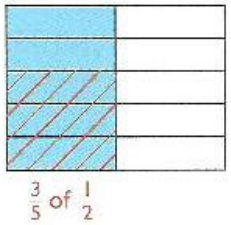


$$\frac{1}{2} \text{ of } \frac{3}{5} = \frac{1}{2} \times \frac{3}{5} = \frac{1 \times 3}{2 \times 5} = \frac{3}{10}$$

Paul draws an identical rectangle and colours $\frac{1}{2}$ of it blue.



He then draws red stripes over $\frac{3}{5}$ of the coloured part.



$$\frac{3}{5} \text{ of } \frac{1}{2} = \frac{3}{5} \times \frac{1}{2} = \frac{3 \times 1}{5 \times 2} = \frac{3}{10}$$

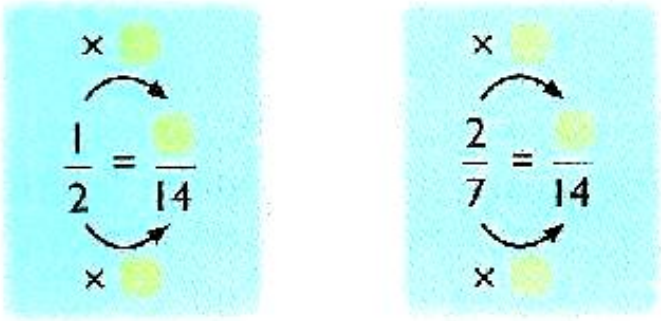
Do Margie and Paul get the same answer?

We say $\frac{1}{2}$ of $\frac{3}{5}$ $\frac{3}{5}$ of $\frac{1}{2}$.

There are parts in each of Margie's and Paul's rectangles.
coloured parts in each rectangle have red stripes.
— of each rectangle has red stripes.

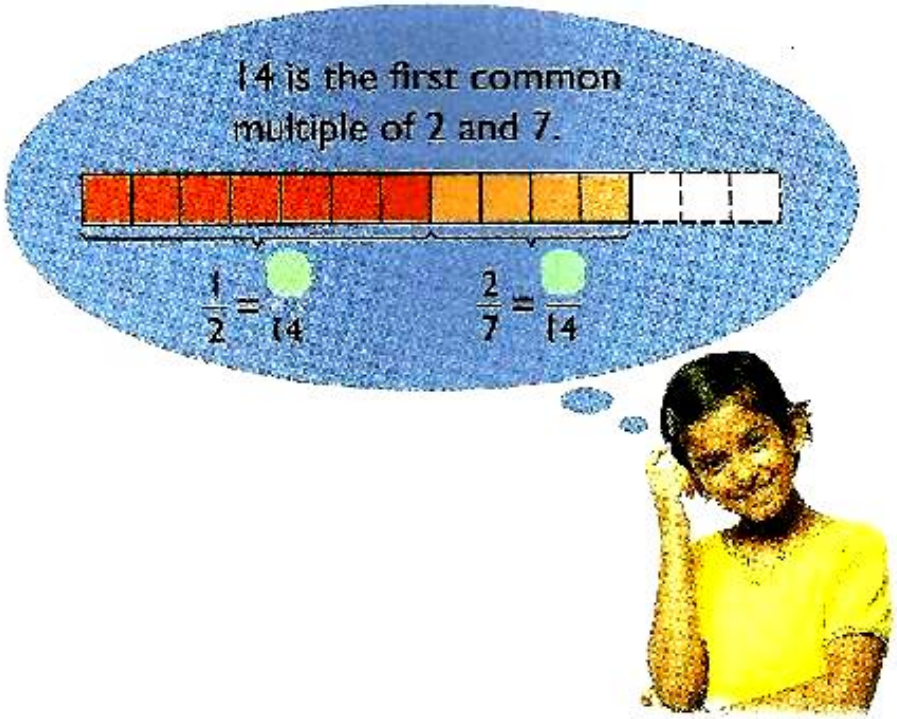
MP 5A – p.72

2 Add $\frac{1}{2}$ and $\frac{2}{7}$.



$$\frac{1}{2} + \frac{2}{7} = \frac{\quad}{14} + \frac{\quad}{14}$$

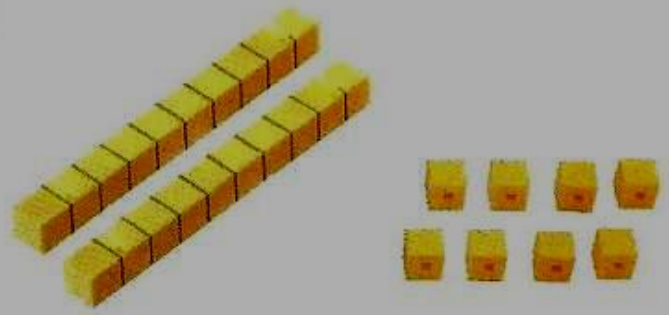
$$= \frac{\quad}{\quad}$$



Maths Champion 1, p. 115

3. Fill in the blanks.

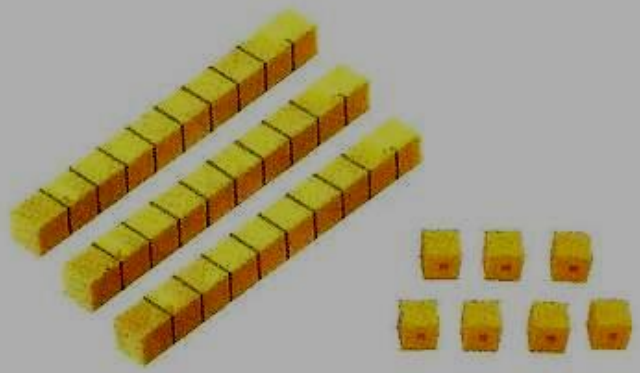
(a)



Tens	Ones

28 = ____ tens ____ ones

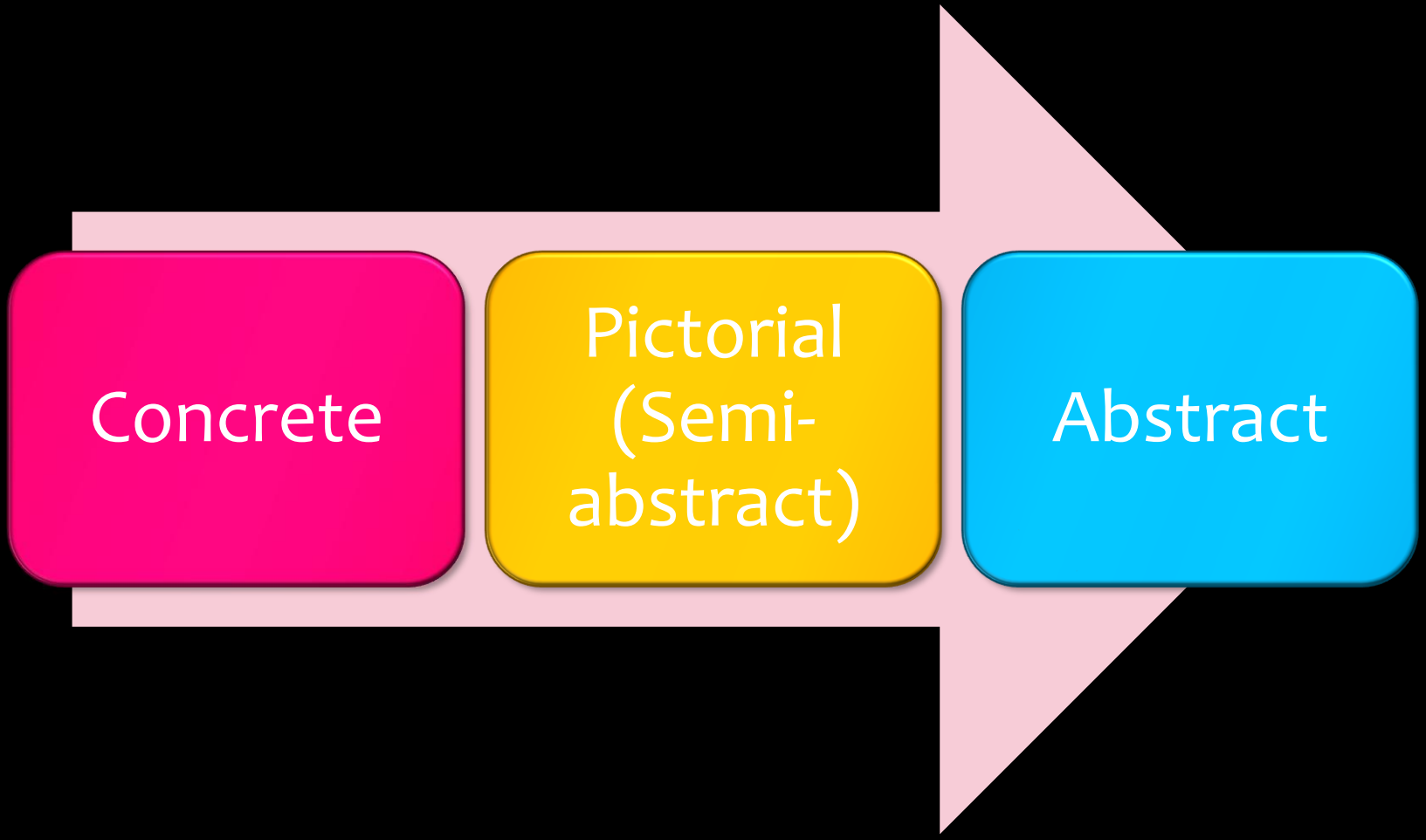
(b)



Tens	Ones

37 = ____ tens ____ ones

Bruner's Theory

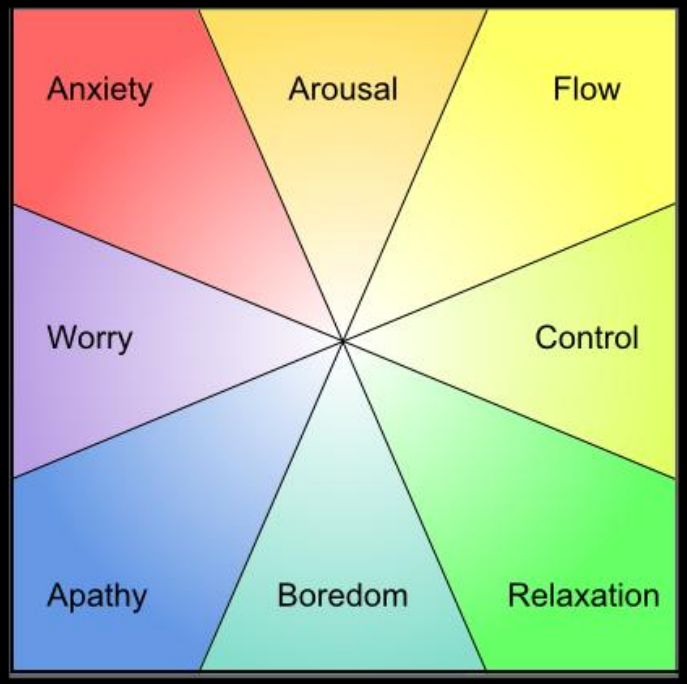


Hock Tim and Ali had 96 marbles altogether. Hock Tim lost 24 marbles to Ali during a game. At the end of the game, Ali had twice as many marbles as Hock Tim. How many marbles did Ali have at the beginning? (MP 4A, p. 67)

Intrinsic Motivation through Challenge and Support

Pada era sekarang, pembelajaran matematika sangat memperhatikan motivasi diri setiap siswa

- Penumbuhan motivasi intrinsik dilakukan melalui tantangan yang wajar serta dukungan yang berimbang
- Pengurangan ancaman dalam pembelajaran
- Pengurangan sogokan dalam pembelajaran



Problem solving

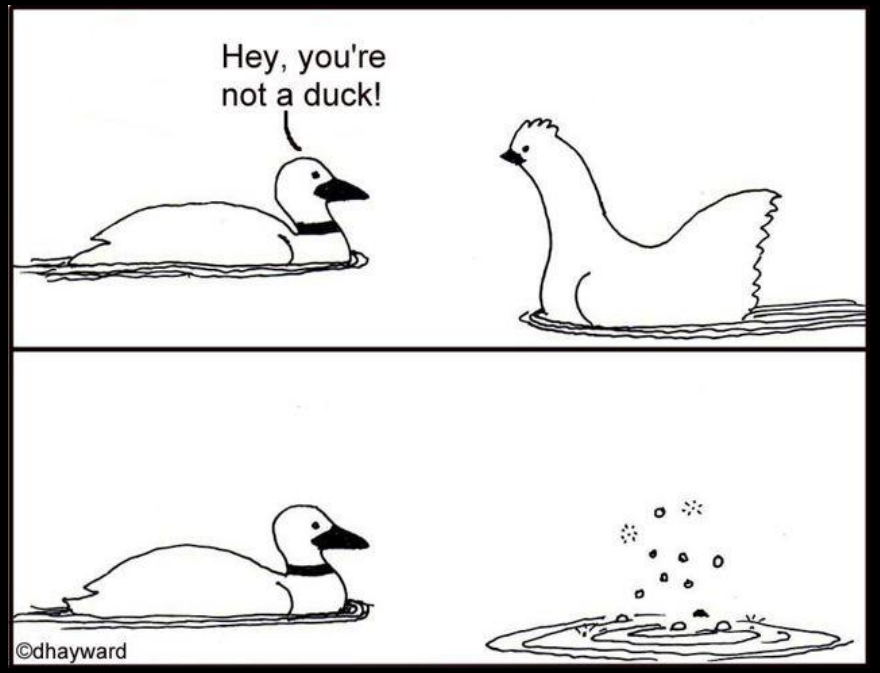
Pemecahan masalah menjadi bagian terpadu dari pembelajaran matematika, bukan kegiatan terpisah.

Kecakapan memecahkan masalah semakin relevan di abad 21 ini.

We only think when confronted with a problem.
- John Dewey, *quoted in Harper's Quotes.*

MP 5B, p. 59

- The average mass of a chicken and a duck is 5 kg. The duck is 1.6 kg heavier than the chicken. Find the mass of the duck.



Iwan Pranoto 2010

Video Pembelajaran

Dengan Internet dan komunikasi data yang sangat terjangkau saat ini, penyampaian pembelajaran matematika bermutu dapat disebarkan secara mudah dan cepat, serta sangat murah.

- Contoh:
  - www.khanacademy.org
  - www.youtube.com
  - dsb

TERIMA KASIH

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