Pentagon Curriculum Framework

Beliefs
- Interest
- Appreciation
- Confidence
- Perseverance

Mathematical
- Numerical calculation
- Algebraic manipulation
- Spatial visualisation
- Data analysis
- Measurement
- Use of mathematical tools
- Estimation

Problem Solving
- Reasoning, communication and connections
- Thinking skills and heuristics
- Application and modelling

Skills
- Numerical
- Algebraic
- Geometrical
- Statistical
- Probabilistic
- Analytical

Concepts
- Monitoring of one’s own thinking
- Self-regulation of learning

Processes
- Attitudes
- Metacognition

Created in 1989
Using the Pentagon Framework to Generate Questions to Assess Mathematics Learning

WONG Khoon Yoong (Dr)
Maths & Maths Education
National Institute of Education, NTU
khoon.y.wong@gmail.com
http://math.nie.edu.sg/kywong
My Background

• 1972, BSc (Hons), Dip Ed (Tasmania)
• 10 years, Malaysia, taught maths, Form 1 – Upper 6
• 1984, PhD (Queensland)
• 1986, 4+ years, Institute of Education (Singapore)
• 1990, 5+ years, Curtin, Murdoch (Perth)
• 1996, 6 years, Universiti Brunei Darussalam
• 2002 – June 2014, 12 years, NIE
• To retire in July, after 40 years in education
• Pedagogy, assessment, curriculum, action research, international studies, Masters, PhD supervision
• Consultancy: Philippines, Hong Kong, Chile, US
Overview

1. 15 min: Aims
2. 50 min: Design Pentagon Questions
3. 30 min: Questioning Sequence
4. 10 min: Implement and Reflect
5. 5 min: Conclusion

Please ask questions and share your ideas: Any time
Aims

• Pentagon defines: curriculum goals; 5 key factors to help students become better problem solvers
• This session on a new approach: use it to craft different types of questions to plan lessons, to assess student learning
• Pre-planned vs. impromptu, possible student responses
Advantages

• Cover cognitive, affective, metacognitive domains to enrich student learning, multi-dimensional

• Complement common approach: Bloom taxonomy, convergent vs. divergent questions, high order vs. low order

• Align curriculum goals, teaching and assessment
Pentagon Questions: Overview

<table>
<thead>
<tr>
<th>Components</th>
<th>Key Ideas</th>
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<tbody>
<tr>
<td>Concepts</td>
<td>1. Meanings, definitions, representations</td>
</tr>
<tr>
<td></td>
<td>2. Examples, non-examples, facts</td>
</tr>
<tr>
<td></td>
<td>3. Connections</td>
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<tr>
<td>Skills (Methods)</td>
<td>1. Steps, procedures</td>
</tr>
<tr>
<td></td>
<td>2. Conditions of use</td>
</tr>
<tr>
<td>Processes</td>
<td>1. Reasoning, inductive justification, deductive proofs</td>
</tr>
<tr>
<td></td>
<td>2. Communication</td>
</tr>
<tr>
<td></td>
<td>3. Applications</td>
</tr>
<tr>
<td>Metacognition</td>
<td>1. Monitor problem solving process, unstuck</td>
</tr>
<tr>
<td></td>
<td>2. Look back, make sense, extend</td>
</tr>
<tr>
<td></td>
<td>3. Self-regulated learning</td>
</tr>
<tr>
<td>Attitude</td>
<td>1. Motivation, engagement</td>
</tr>
<tr>
<td></td>
<td>2. Enjoyment</td>
</tr>
<tr>
<td></td>
<td>3. Confidence, self-efficacy</td>
</tr>
</tbody>
</table>

Wong (AME-SMS Workshop 2014)
## Question Formats

<table>
<thead>
<tr>
<th>Question</th>
<th>What is … ?</th>
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</thead>
<tbody>
<tr>
<td>An instruction as a question</td>
<td>Tell me …</td>
</tr>
<tr>
<td>A statement requiring a response</td>
<td>I like to know more about what you are thinking …</td>
</tr>
</tbody>
</table>

Different ways to ask the same question
Design Pentagon Questions

- Handout on Pentagon Questions
- Pentagon Questions Cards (PQC)
- Classification of questions into “rigid” categories, not important; raise awareness of varieties
Questioning Sequence

- Plan a sequence of questions; variety, levels
- Handout on Consecutive Numbers: Questions to ask for two different approaches
# Q&A and Phases of Lesson

<table>
<thead>
<tr>
<th>Phases</th>
<th>Pentagon Questions</th>
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</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>New concept</td>
<td></td>
</tr>
<tr>
<td>Worked examples</td>
<td></td>
</tr>
<tr>
<td>Practice, seatwork</td>
<td></td>
</tr>
<tr>
<td>Closure</td>
<td></td>
</tr>
</tbody>
</table>
Implement & Reflect

• Take many hours to learn new Q&A skills!
• Select questions to trial:
  o Next week
  o Next term
  o Next year
• Reflect on experience:
  o Write teaching log
  o Talk with colleagues at meetings and informally
  o Reading on questioning and discussion
<table>
<thead>
<tr>
<th>Goals</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next week: Write 3 new questions</td>
<td></td>
</tr>
<tr>
<td>Next term: Questioning sequence for a topic</td>
<td></td>
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</tbody>
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