

## Appendix Processes uncovered

The following listing provides possible components for the six processes.

- Problem solving (including investigating)

<p>(i) plan</p> <ul style="list-style-type: none"> <li>• identify, describe and solve problems;</li> <li>• inquire, explore, generate, design, measure and make;</li> <li>• formulate a plan and identify sub-tasks;</li> <li>• decide whether sufficient information is known;</li> <li>• locate, gather and retrieve information;</li> <li>• distinguish between important and irrelevant information.</li> </ul>	<p>(ii) strategies</p> <ul style="list-style-type: none"> <li>• guess and check;</li> <li>• make a list; draw a picture, table or graph;</li> <li>• find a pattern, a relationship, and/or a rule;</li> <li>• make a model;</li> <li>• solve a simpler problem first;</li> <li>• work backwards;</li> <li>• eliminate possibilities;</li> <li>• try extreme cases;</li> <li>• write a number sentence;</li> <li>• act out a problem;</li> <li>• restate the problem;</li> <li>• check for hidden assumptions;</li> <li>• change the point of view;</li> <li>• recognise appropriate procedures and justify them.</li> </ul>
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- Mathematical modelling

<p>(i) general</p> <ul style="list-style-type: none"> <li>• use concrete materials;</li> <li>• use Cartesian and other graphs to model change;</li> <li>• use lines, networks, and tree diagrams to represent relationships and sequences;</li> <li>• use flow diagrams to represent procedures;</li> <li>• use formulae to model relationships;</li> <li>• use diagrams and three dimensional models to model geometric situations; and</li> <li>• apply the process of mathematical modelling to real world problems.</li> </ul>	<p>(ii) translating</p> <ul style="list-style-type: none"> <li>• restate the real problem as a mathematical problem;</li> <li>• use estimation to check the solution;</li> <li>• verify and interpret results with respect to the original question; and</li> <li>• recognise that the best maths solution may not be the best real solution.</li> </ul>
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- Reasoning

<p>(i) classification and description</p> <ul style="list-style-type: none"> <li>• sort and classify objects;</li> <li>• describe objects and procedures unambiguously and give definitions; and</li> <li>• organise information to support logic and reasoning.</li> </ul> <p>(iii) reasoning</p> <ul style="list-style-type: none"> <li>• draw logical conclusions;</li> <li>• use models, facts, properties and relationships to provide reasons;</li> <li>• justify answers and procedures;</li> <li>• use patterns and relationships to analyse situations;</li> <li>• develop confidence with spatial reasoning;</li> <li>• develop confidence with graphical reasoning (interpretation of graphs);</li> <li>• recognise the meanings of true, false and not proven; follow logical arguments;</li> <li>• judge the validity of arguments;</li> <li>• construct simple valid arguments;</li> <li>• recognise and apply deductive reasoning;</li> <li>• recognise and apply inductive reasoning;</li> <li>• formulate counter examples;</li> <li>• appreciate the pervasive use and power of reasoning as a part of mathematics.</li> </ul>	<p>(ii) inferring</p> <ul style="list-style-type: none"> <li>• make and evaluate mathematical conjectures;</li> <li>• infer, interpolate, and extrapolate;</li> <li>• make and test hypotheses;</li> <li>• make generalisations; and</li> <li>• make appropriate and responsible decisions).</li> </ul> <p>(iv) proving</p> <ul style="list-style-type: none"> <li>• appreciate the axiomatic nature of mathematics; and</li> <li>• construct proofs for mathematical assertions including indirect and inductive proofs.</li> </ul>
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- Communicating

<p>(i) personal</p> <ul style="list-style-type: none"> <li>relate to others; and</li> <li>work cooperatively.</li> </ul> <p>(ii) general</p> <ul style="list-style-type: none"> <li>understand what needs to be done in broad terms;</li> <li>reflect on and clarify thinking;</li> <li>relate everyday language to mathematical language, understand mathematical vocabulary;</li> <li>formulate definitions;</li> <li>express generalisations.</li> </ul> <p>(iii) listening and speaking</p> <ul style="list-style-type: none"> <li>follow instructions from the teacher;</li> <li>discuss difficulties;</li> <li>ask questions;</li> <li>present and explain results to others;</li> <li>discuss the implications and accuracy of conclusions;</li> <li>discuss other possible interpretations of conclusions.</li> </ul>	<p>(iv) reading and writing</p> <ul style="list-style-type: none"> <li>follow instructions from a text or a computer;</li> <li>debate possible courses of action with others;</li> <li>use reference material; and</li> <li>make a report.</li> </ul> <p>(v) representing</p> <ul style="list-style-type: none"> <li>use graphs and diagrams to depict mathematical ideas visually;</li> <li>use symbols to represent ideas precisely;</li> <li>explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations;</li> <li>appreciate the economy, power, and elegance of mathematical notation.</li> </ul>
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- Making connections

<p>(i) within mathematics</p> <ul style="list-style-type: none"> <li>link concepts, procedures, and topics in mathematics;</li> <li>relate various representations of a concept or procedure to one another;</li> <li>recognise equivalent representations;</li> <li>see mathematics as an integrated whole.</li> </ul> <p>(ii) other curriculum areas</p> <ul style="list-style-type: none"> <li>use mathematics in other school subjects</li> </ul>	<p>(iii) everyday life</p> <ul style="list-style-type: none"> <li>use mathematics in everyday life, in work and leisure activities;</li> <li>relate results to one's everyday experienced world.</li> </ul> <p>(iv) general</p> <ul style="list-style-type: none"> <li>apply mathematics to familiar and unfamiliar situations;</li> <li>value the relationship between mathematics and history, culture and society.</li> </ul>
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- Using tools

<p>(i) instruments</p> <ul style="list-style-type: none"><li>• use measuring and drawing instruments.</li></ul> <p>(ii) calculators</p> <ul style="list-style-type: none"><li>• use simple, scientific, graphical, symbol manipulating calculators.</li></ul>	<p>(iii) computers</p> <ul style="list-style-type: none"><li>• use computers, and general applications such as word processing, databases, spreadsheets;</li><li>• use the Web as a resource for information;</li><li>• use specialist packages for handling and graphing data, for symbol manipulation and graphing, and for dynamic geometry.</li></ul>
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Source: Begg, A. (1994/1996) in Neyland, J. (ed) *Mathematics Education: A Handbook for Teachers, Volume 1*, Masterton nz: Wairarapa Education Resource Centre / Reston va: National Council of Teachers of Mathematics, (pp. 183–1920).