**Problem Solving Statements and Keywords by Year Level**

**Problem Solving (Involves thinking, reasoning and communicating) (Strategic Competence)**

Students develop the ability to make choices, interpret, formulate, model and investigate problem situations, and communicate solutions effectively. Students formulate and solve problems when they use mathematics to represent unfamiliar or meaningful situations, when they design investigations and plan their approaches, when they apply their existing strategies to seek solutions, and when they verify that their answers are reasonable.

From Kilpatrick et al: strategic competence*—* ability to formulate, represent, and solve mathematical problems

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| Year | Description | Keyword |
| P | *Problem Solving* includes using materials to model authentic problems, sorting objects, using familiar counting sequences to solve unfamiliar problems, and discussing the reasonableness of the answer | Model, sorting, solve, discuss reasonableness |
| 1 | Problem Solving includes using materials to model authentic problems, giving and receiving directions to unfamiliar places, and using familiar counting sequences to solve unfamiliar problems and discussing the reasonableness of the answer | Model, communicate directions, solve, discuss reasonableness |
| 2 | Problem Solving includes formulating problems from authentic situations, making models and using number sentences that represent problem situations, and matching transformations with their original shape | Formulate, model, comparison matching, planning, |
| 3 | *Problem Solving*includes formulating and modelling authentic situations involving planning methods of data collection and representation, making models of three-dimensional objects and using number properties to continue number patterns | Formulate, model, planning, continuing number patterns |
| 4 | *Problem Solving* includes formulating, modelling and recording authentic situations involving operations, comparing large numbers with each other, comparing time durations, and using properties of numbers to continue patterns | Formulate, model, record, compare, continuing patterns |
| 5 | *Problem Solving* includes formulating and solving authentic problems using whole numbers and measurements and creating financial plans | Formulate, creating financial plans |
| 6 | Problem Solving includes formulating and solving authentic problems using fractions, decimals, percentages and measurements,  interpreting secondary data displays, and  finding the size of unknown angles | Formulate, solve, interpret, |
| 7 | Problem Solving includes formulating and solving authentic problems using numbers and measurements, working with transformations and identifying symmetry, calculating angles and interpreting sets of data collected through chance experiments | Formulate, solve, identifying “symmetries”, interpret |
| 8 | *Problem Solving* includes formulating, and  modelling  practical situations involving ratios, profit and loss, areas and perimeters of common shapes, and using two-way tables and Venn diagrams to calculate probabilities | Formulate, model, convert/translate information |
| 9 | *Problem Solving* includes formulating, and  modelling  practical situations  involving surface areas and volumes of right prisms, applying ratio and scale factors to similar figures, solving problems involving right-angle trigonometry, and collecting data from secondary sources to investigate an issue | Formulate, model, apply, solve, investigate, application, collecting data, investigate |
| 10 | Problem Solving includes calculating the surface area and volume of a diverse range of prisms to solve practical problems, finding unknown lengths and angles using applications of trigonometry, using algebraic and graphical techniques to find solutions to simultaneous equations and inequalities, and investigating independence of events | Apply, investigate, |
| 10A |  |  |

Four Stages of Problem Solving

Polya: How to Solve it (1945). P xix

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| First.  You have to *understand*  the problem. | UNDERSTANDING THE PROBLEM  *What is the unknown1 What are the data? What is the condition?*  Is it possible to satisfy the condition? Is the condition sufficient to determine the unknown? Or is it insufficient? Or redundant? Or contradictory?  Draw a figure. Introduce suitable notation.  Separate the various parts of the condition. Can you write them down? |
| Second.  Find the connection between *the* data and the unknown.  You may be obliged  to consider auxiliary problems if an immediate connection  cannot be found.  You should obtain eventually a *plan* of the solution. | DEVISING A PLAN  Have you seen it before? Or have you seen the same problem in a slightly different form?  *Do you know a related problem'!* Do you know a theorem that could be useful?  *Look at the unknown!* And try to think of a familiar problem having the same or a similar unknown.  *Here is a problem related to yours and solved before. Could you use it?*  Could you use its result? Could you use its method? Should you introduce some auxiliary element in order to make its use possible?  Could you restate the problem? Could you restate it still differently?  Go back to definitions.  If you cannot solve the proposed problem try to solve first some related problem. Could you imagine a more accessible related problem'? A more general problem? A more special problem'? An analogous problem?  Could you solve a part of the problem? Keep only a part of the condition, drop the other part; how far is the unknown then determined, how can it vary? Could you derive something useful from the data?  Could you think of other data appropriate to determine the unknown?  Could you change the unknown or the data, or both if necessary, so that the new unknown and the new data are nearer to each other?  Did you use all the data? Did you use the whole condition? Have you taken into account all essential notions involved in the problem? |
| Third.  *Carry out* your plan, | CARRYING OUT THE PLAN  Carrying out your plan of the solution, *check each step.* Can you see clearly that the step is correct? Can you prove that it is correct? |
| Fourth.  *Examine* the solution obtained. | LOOKING *Back*  Can you *check the result?* Can you check the argument?  Can you derive the result differently? Can you see it at a glance?  Can you use the result, or the method, for some other problem? |