

reSolve: Promoting a Spirit of Inquiry

THE AUSTRALIAN ACADEMY OF SCIENCE IS AT THE FOREFRONT OF AN EXCITING PROJECT THAT AIMS TO FOSTER STUDENT CURIOSITY AND A DESIRE TO KNOW WHY IN MATHEMATICS, PROMOTING WHAT THEY REFER TO AS A SPIRIT OF ENQUIRY.



In his 2010 speech to young researchers in Mathematics at Cambridge University, renowned mathematician, Fields medallist and Abel Prize winner Sir Michael Atiyah looked back on 60 years of Mathematics. Upon reflection, Atiyah referred to the “views I have seen from the heights” and the “challenges [that] lie ahead for the next generation” (Atiyah, 2010). He suggested there were many more “mountain ranges” to explore in Mathematics, and talked about what motivates mathematicians: understanding, curiosity, exploration and ideas.

These concepts lie at the heart of an exciting new Australian government funded project, managed by the Australian Academy of Science in collaboration with the Australian Association of Mathematics Teachers. The project, reSolve: Maths by Inquiry, produces classroom and professional resources to promote a spirit of inquiry in school Mathematics from Foundation to Year 10. But what is a spirit of inquiry? The reSolve team describes it as a desire to know why an answer has been developed and a curiosity for this, as opposed to simply understanding the methodology behind each individual problem. It will also develop the knowledge and skills of more than 240 teachers across Australia who will become the champions to take the messages of the project out into the world.

THE PROTOCOL

The guiding principles behind the project are described in what the reSolve team has called the Protocol – a vision for the teaching of Mathematics and numeracy that emphasises mathematical purpose, challenge and access, and a collaborative knowledge-building culture. The three principal elements of the Protocol stress that Mathematics is more than covering content, that if we design tasks well, everyone can be part of a rich mathematical experience, and that classrooms are learning environments focused on developing deep understanding.

Here is one example of how the reSolve resources promote a spirit of inquiry in school Mathematics.

ADDITION CHAIN

Addition Chain is an algebra activity aimed at the early years of secondary school. It commences with a “trick” that students are invited to explain. Students write down any two numbers, add them to make a third number, add the third to the second to make the fourth and so on. They complete an Addition Chain 10 numbers long, such as:

5, 7, 12, 19, 31, 50, 81, 131, 212, 343.



They then add the 10 numbers, which in this case is 891. Before they even add the numbers, the teacher can tell them the answer, which is 11 times the seventh number.

The explanation, of course, lies in algebra. If the first two numbers are a and b , the seventh is $5a + 8b$, and the sum of the 10 numbers is $55a + 88b$.

This is by no means an original activity, and is shown on a number of websites and YouTube clips. But what the reSolve lesson does next is invite students to find and explain other relationships, such as that if you add six numbers, you get four times the fifth number, or if you add 14 numbers you get 29 times the ninth number. When reSolve developed the activity it looked at the sequence of relationships, which are:

$$\begin{aligned} s_2 &= 1t_3 \\ s_6 &= 4t_5 \\ s_{10} &= 11t_7 \\ s_{14} &= 29t_9 \\ s_{18} &= 76t_{11} \end{aligned}$$

The reSolve team said it had never seen these results anywhere, and were curious about the sequence of numbers (1, 4, 11, 29, 76). They typed them into the Online Encyclopaedia of Integer Sequences and found that they are the even numbered terms in the Lucas sequence: 2, 1, 3, 4, 7, 11, 18, 29. The Lucas sequence is an integer sequence named after 19th century mathematician François Édouard Anatole Lucas. reSolve have since managed to explain why the relationships work and what the link is with the Lucas sequence. Students can start with Mathematics that everyone can do, and then move in a

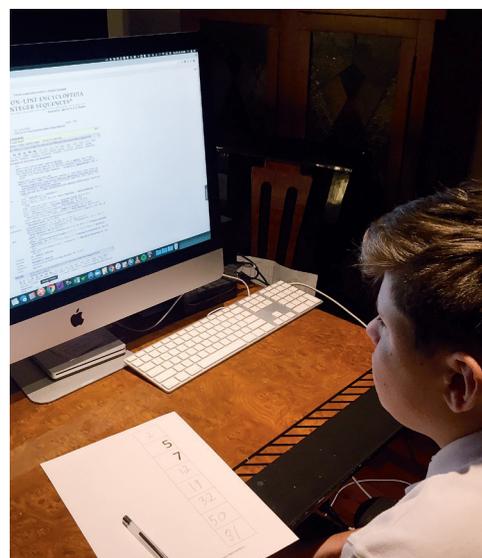
direction that is new and exciting.

THE RESOURCES

reSolve: Maths by Inquiry is developing three types of resources that capture the spirit of inquiry in Maths, exemplify the Protocol and promote fluency, deep understanding, strategic problem solving and mathematical reasoning.

More than 88 exemplary lesson plans will highlight key ideas in every strand of the Australian Curriculum: Mathematics, at every year level from Foundation to Year 10. Each lesson plan is carefully designed to develop a progressive understanding through tasks that promote a spirit of inquiry.

The special topics are significant resources that address the needs of 21st century learners. They provide imaginative opportunities for creatively using



INQUIRY AND EXPLICIT TEACHING:

The word explicit comes from the Latin words *ex* (out) and *plicare* (to fold). To make something explicit literally means “to unfold”.

This is in line with reSolve's view of inquiry, which focuses on unpacking important Mathematical ideas, such as coming to understand how algebra helps to explain arithmetic results.

The reSolve resources are designed to help the teacher lead students to a deep understanding of purposeful Mathematics.

Students learn through the teacher's active intervention, such as the use of enabling prompts, which reduces cognitive load.

The resources do much more than reproduce an approach demonstrated by the teacher, they understand the Mathematical concepts underpinning the method and appreciate why it is accurate and efficient.

new technologies in real-world contexts such as coding, modelling and engineering.

The professional resources provide the link between the Protocol and the teaching and learning resources. They are designed to inform individual teacher and whole-school change.

CONCLUSION

The example above captures the spirit of inquiry that reSolve hopes will permeates all its resources.

The resources do not eliminate the need for carefully constructed intentional teaching, nor do they eliminate the need for activities that will sustain the learning.

But like the young mathematicians addressed by Sir Michael Atiyah, through activities such as these, reSolve hopes that students begin to find their own mountain ranges to explore, motivated by understanding, curiosity, exploration and ideas. It hopes that they too, can experience the joy and delight of mathematical discovery.

reSolve invites you and your colleagues to join us in the exciting venture that is reSolve: Maths by Inquiry. Visit our website at www.resolve.edu.au or email us at mbi@science.org.au.

References

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