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Moving forwards by walking backwards: Inverse problems in Te Ara Mokoroa

We often speak of learning as movement in a forward direction: we progress up a level, we journey along a trajectory. By contrast, the images we use to describe particularly deep kinds of knowledge often imply movement in the inverse direction. “*She knows her topic inside out*”, “*He knows it back to front*”. In mathematics, inverse problems are often more difficult than their direct counterparts: subtracting is harder than adding; dividing is harder than multiplying; factorising is harder than expanding. Yet, mastering a mathematical process in the inverse direction often leads to a deeper understanding of the process in the forwards direction, as well as a deeper appreciation of the generality of the process and its underlying mathematical structure.

Such was the case for eight undergraduate students who worked on inverse problems in calculus and ratios. Although the students were all adept at working in the forward direction they struggled when asked to solve the problem in the inverse direction. The students adapted their knowledge of the problems in the forward direction to make the inverse problem easier, but did so in different ways that revealed the depth of their mathematical understanding in these topics.