

Quadratic Equations*

A glimpse into what researchers say:

- Students' difficulties with the quadratic equations might be because:
 - They are not flexible choosing between different methods⁶. Factorisation and quadratic formula are the most popular methods and students might be confused by other, potentially more efficient, methods.
 - They have difficulties with the concept of the square root making equations such as $(81 - x)^2 = 81$ hard for them to solve¹.
 - They have difficulties with the factorisation¹ (e.g. guess incorrect factors, attempt factorization of non-factorable quadratic equations, incorrect use of either difference of two squares or the greatest common factor techniques).
 - They often miss out zero² as a root of equations, such as $2x^2 = 3x$; they may cancel one x from each side of the equation.
 - Students sometimes know how to solve a quadratic equation but they do not know how to interpret the results⁹.
- Sometimes students prefer one method than another⁸. For example, Brazilian students prefer the quadratic formula instead of factorisation even for equations such as $(x - 3)(x - 2) = 0$; is this because they practice most on the quadratic formula in school?

A glimpse into what practitioners say:

- There are several techniques for the factorisation of quadratics^{3, 4, 5}, such as [Cross-multiplication method](#), [Guess and check method](#), [Split term](#), [AC](#), [Lizzie's Method](#).
- Quadratic equation should be understood by GCSE students and not just viewed as "maths magic"⁷. Combination of different methods and the function graph can help the students to understand the secrets behind the formula.

Different Approaches to solving quadratic equations:

1. Factorisation⁵ of $ax^2 + bx + c = 0$ into $a(x + p)(x + q) = 0$ or $(ax + p)(x + q) = 0$ or $(a_1x + p)(a_2x + q) = 0$
2. [Completing the square](#)
3. Quadratic formula
4. Graph the equation
5. Graph the quadratic equation, the solutions of the quadratic are where the graph crosses the x-axis.

Some problems you can try with your class ...

1. Solve $2x^2 - 7x + 6 = 0$ with different methods
2. Solve $5x^2 = 4x$
3. Solve $2x^2 = 32$

¹ Didis, M.G. and Erbas, A.K. (2015) Performance and Difficulties of Students in Formulating and Solving Quadratic Equations with One Unknown. *Educational Sciences: Theory & Practice*, 15(4), pp. 1137-1150.

² Didis, M.G., Bas, S. and Erbas, A.K. (2011). Students' reasoning in quadratic equations with one unknown. In M. Pytlak, T. Rowland & E. Swoboda (Eds.), *Proceedings of the 7th Conference of European Research in Mathematics Education (CERME)*. (pp. 1981-1991). Rzeszów, Poland.

³ Fisher, I. (2005). Maths resource: Quadratics! *Mathematics in School*, 34(3), pp. 17-19.

⁴ Hoong, L.Y. et al. (2010). Concreting factorisation of quadratic expressions. *Australian Mathematics Teacher*, 66(3), 19-24.

⁵ Kemp, A. (2010). Factorizing Quadratics. *Mathematics in School*, 39(4), 44-45.

⁶ Lopez, J., Robles, I. and Martinez-Planell, R. (2016) Students' understanding of quadratic equations. *International Journal of Mathematical Education in Science and Technology*, 47(4), 552-572.

⁷ Seager, M. (2007). The quadratic formula and completing the square: A fresh look. *Mathematics in School*, 36(2), 2.

⁸ Tall, D., Nogueira de Lima, R. and Healy, L. (2014). Evolving a three-world framework for solving algebraic equations in the light of what a student has met before. *The Journal of Mathematical Behaviour*, 34, 1-13.

⁹ Vaiyavutjamai, P., Ellerton, N. and Clements, K. (2005). *Students' attempts to solve two elementary quadratic equations: A study in three nations*. Retrieved from <https://www.merqa.net.au/documents/RP852005.pdf>.