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Harnessing the power of theatre and dialogue to integrate history more effectively into mathematics education

Abstract

This talk aims to motivate and exemplify a neglected means of exhibiting the human drama of mathematics-making, and communicating a sympathetic understanding of mathematicians in their historical context. Use of theatre has the potential to bring vividly to life the people and events behind the abstract concepts of the mathematics curriculum.

The talk may serve as an introduction and motivation for the ESU-8 workshop on "Bringing episodes in the history of mathematics to life in the classroom by means of theatre", in which participants will be invited to cooperatively stage and then critique a play about Niels Abel: "*So many Ideas …*". But the talk also stands alone, making the case for wider use of the powerful tool of theatre, illustrated by lively extracts from another play, featuring John Wallis in the late 17th century on negative numbers, and Carl Friedrich Gauss and Augustin-Louis Cauchy debating in the 1830s on the re-naming of "impossible numbers" as "complex numbers".

Exploring the intellectual adventure through which notions like "irrational", "fictional", "false", "real", "imaginary", and "impossible", were negotiated, re-defined, named and (sometimes) re-named in the story of mathematics-making, is critical for both history and pedagogy. In the final full acceptance of "impossible" numbers, and their more respectful re-naming as "complex numbers", the authority of Gauss was central. In contrast, the long drawn-out resistance of Cauchy is a fascinating case-study, showing that skill in formal manipulation and willingness to make fruitful application are only partial stages on the journey towards embracing mathematical objects in and for themselves. The establishment of the negative number system was historically (and still is in the classroom) achieved by blending the ideas of geometrical number line and algebraic rules. Similarly, the final step in the establishment of the complex number system, for the pioneers and for numerical cognition of students today, is achieving a fully blended conceptualization of the complex plane and the algebra of complex numbers. This blending is accompanied by a transformation in perception of numbers, from representing objects to representing relations. This process of transformation will be illustrated in the historical dialogue, providing a new tool for responding to the conceptual difficulties faced by learners today, and encouraging them to see negatives and complex numbers as wonderful products of a human quest.

The devices of theatre and dialogue can help us to enter into the struggles and excitement of historical characters, as they worry, argue, negotiate and begin to warm to a concept and finally embrace it, until it becomes an integrated part of the fabric of their mental life. Such sharing of the journeys of the people who gave us, named, and re-named mathematical ideas, can have profound consequences for our understanding and mentoring of the journeys our students must make.

The speech of Wallis is based on passages in his *A Treatise of Algebra* of 1685, and the dialogue between Gauss and Cauchy is based on passages in Gauss's paper, *Theoria residuorum biquadraticorum, commentatio secunda* of 1831, together with various extracts from Cauchy's writings over many decades.

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