The Contribution of Research in Mathematics Education to Curriculum Improvement

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The Government, in its commitment to improving the National Curriculum for mathematics, published a document entitled "The Case for Change". This document summarises a range of evidence, primarily from educational research, which points to nature of the content of the curriculum being one of the significant factors influencing the success of an education system. Research that focuses specifically on mathematics education in the UK, through dedicated research centres at a number of UK universities and through the

British Society for Research into Learning Mathematics, is particularly well-developed and is well-placed to make important contributions to curriculum Improvement. The purpose of this article is to point in brief to elements of research in mathematics education that can inform curriculum Improvement, and to indicate some components of the mathematics curriculum that would benefit from additional research.

At the primary school level and beyond, research in mathematics education shows that children's understanding of number, and their development of meaningful problem-solving strategies in arithmetic, depends on them acquiring well-connected knowledge of concepts, procedures and facts. Research indicates that an effective curriculum is one that enables children to apply more than one type of arithmetic knowledge to problems. With such a curriculum, young children can bring the procedural and conceptual aspects of number into interaction, thereby enhancing the development of their procedural and conceptual knowledge in arithmetic. This, the research evidence shows, is something which occurs iteratively, rather than one preceding the other.

Across the primary and secondary curriculum, measurement is a topic that connects and enriches the two crucial mathematical domains of geometry and number (and thence algebra through measurement formulae). Indeed understanding quantities through measurement is a key route to understanding number. While measurement is something that is all-pervasive within school mathematics, research indicates that it is a somewhat neglected topic in the mathematics curriculum especially at the secondary school level. Such a lack of curricular focus on measurement, research suggests, is likely to be responsible for problems for learners as they move towards more advanced mathematical concepts such as functions, loci, vectors, and so on.

Geometry is a key component of the school mathematics curriculum, and, if anything, is becoming more important in industry and the wider society. Across the primary and secondary curriculum, research indicates that the geometry curriculum, across both 2D (plane) and 3D (solid) geometry, needs to attend to the twin aspects of geometry: the spatial aspects, and the aspects that relate to reasoning with geometrical theory. The former involves spatial thinking and visualisation, while the latter involves deductive reasoning using approaches employing, where appropriate, congruency and/or geometric transformations. Available research indicates that these twin aspects of geometry are not separate; they are entwined and need to be treated as such in the specification of the geometry component of the mathematics curriculum.

While the above evidence illustrates the scale of the contribution that research in mathematics education can make to curriculum improvement, there remain many aspects of the design of the mathematics curriculum that are under-researched. Two significant topics that would benefit from additional research are the topics of mathematical similarity and of trigonometry. Mathematical similarity is a geometry topic that is at the heart of learners' understanding of ratio and proportion. Such ideas of similarity then become very significant is in the definition of the six initial trigonometric functions: sine, cosine, tangent, cotangent, secant and cosecant. Further research in these topics, and others, would be beneficial to informing curriculum improvement.

Biography:

Keith Jones is deputy director of the Mathematics and Science Education Research Centre at the University of Southampton. He is an expert on mathematics education with an international reputation. He has published widely on geometrical reasoning, the use of technology in mathematics education, and mathematics teacher education.