A blended learning programme for out-of-field mathematics teaching

School principals, confronted by a scarcity of qualified post-primary mathematics teachers, have a tendency to assign mathematics lessons to teachers qualified to teach subjects other than mathematics. This practice, known as ‘out-of-field teaching’, is an international phenomenon with particular prevalence in the teaching of mathematics.

Out-of-field mathematics teachers in secondary schools tend to lack both the knowledge of how to teach mathematics successfully and the depth of mathematical knowledge to ensure students understand the subject. Furthermore, these teachers are inclined to feel their sense of professional competence undermined with lack of confidence, stress and feelings of inadequacy.

The research team at EPISTEM, Ireland’s National Centre for STEM Education based at the University of Limerick, conjectured that out-of-field mathematics teaching may well be contributing to the under-performance of Irish secondary school students in mathematics. They also thought it could be obstructing the successful implementation of the new mathematics curriculum. In 2009, their national survey of mathematics teachers in Irish secondary schools revealed that 48% of the survey’s participants were actually teaching mathematics out-of-field.

Professor Merrilyn Goos, Professor of STEM Education at the University of Limerick, and Director of EPISTEM – the National Centre for STEM Education describes the design of a national blended learning programme – the Professional Diploma in Mathematics for Teaching (PDMT), developed in response to this finding. Funded by the Department of Education and Skills, PDMT provides out-of-field teachers of mathematics with the knowledge and skills to teach mathematics profitably.

A NATIONAL PRIORITY
Raising standards in mathematics is a national priority. The Irish government committed approximately €7 million to funding the mathematics teacher professional development programme from 2012-2020. PDMT, designed by the research team at EPISTEM, is delivered through a national network of 14 higher education institutions. So far, 1086 teachers have graduated from the programme, described by the national media as a “historic step in terms of supporting maths teaching in post-primary schools”.

In 2018, a repeat of the 2009 survey showed a significant decline in the out-of-field teaching of mathematics to only 25% of respondents. Moreover, researchers at EPISTEM have observed the positive effects of the PDMT of the former out-of-field teachers’ teaching practices and beliefs after completing the programme.

MATHEMATICS TEACHER PROFESSIONAL DEVELOPMENT
The PDMT offers professional development for out-of-field teachers of mathematics in line with the new mathematics curriculum and the requirements of the Irish Teaching Council. Post-primary teachers graduating from the two-year part-time programme are deemed to have met the Teaching Council’s requirements for Mathematics teaching in post-primary schools.

PROGRAMME STRUCTURE
The PDMT is a blended professional learning programme. Blended learning, combining both face-to-face and online delivery, is popular in higher education. Participants combine their studies with teaching full-time in schools. The PDMT comprises ten mathematics content modules, delivered online with additional face-to-face and online support, and two mathematics pedagogical modules, delivered face-to-face. The mathematics content modules are presented in six-week sessions, with four lectures and a tutorial each week, covering calculus, algebra, probability, statistics, geometry, problem solving and modelling, and history of mathematics. The mathematics pedagogy modules concentrate on developing pedagogical content knowledge. They are linked to corresponding mathematics content modules so that pedagogical content knowledge and subject content knowledge can be developed in parallel. The latter includes participants completing an action research project on their classroom practice and their compulsory attendance of five three hour workshops together with a weeklong summer school. A wide range of assessment is employed throughout the programme. This includes written assignments, presentations in workshops, mathematics problem sets, supervised examinations and projects.

BOUNDARY CROSSING
Professor Goos explains how the implementation of the PDMT programme is underpinned by ‘boundary crossing’.

Initially, boundary crossing described how professionals in work situations were able to function in fields where they were fundamentally unqualified. This concept has grown to include boundaries between communities, practices, disciplines, and activity systems. This makes boundary crossing a suitable vehicle for the study of a multifarious professional development programme such as PDMT.

DESIGN FEATURES OF THE PDMT
The research question forming the cornerstone of this study is: How does a blended learning environment contribute to effective professional learning for out-of-field teachers of mathematics? In order to answer this, the research team devised a new theoretical model to rationalise the design features of the PDMT programme. They apply the notion of boundary crossing to analyse the design features of the PDMT using three theoretical frameworks to explore the particular combination of factors within this blended learning environment and position this research within the existing literature in this discipline.

THREE THEORETICAL FRAMEWORKS
The research draws on three perspectives or theoretical frameworks to inform the analysis of the blended learning design. Firstly, the blended learning perspective that crosses the boundary between face-to-face and computer-mediated teaching and learning. Secondly, the perspective of the out-of-field teacher crossing discipline boundaries between the subject they are qualified to teach and mathematics. Thirdly, the perspective of the mathematics educators and mathematicians who design and teach the PDMT programme.

BLENDED LEARNING FRAMEWORK
The researchers identified the four critical dimensions of blended learning environments: space, time, fidelity,
The PDAMT is an exemplar model for the professional development of out-of-field mathematics teachers deploying blended learning.

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**Behind the Research**

**Dr. Merrilyn Goos**

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**Research Objectives**

Merrilyn Goos’ research interests include the professional preparation and development of mathematics teachers, numeracy across the curriculum, curriculum and assessment reform, and teaching and learning in higher education.

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**References**


