Teaching and learning introductory differential calculus with a computer algebra system

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Author

Kendal, Margaret

Date

2001-09

Affiliation

Education: Science
Department of Science and Mathematics Education

Metadata

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Document Type

PhD thesis

Citations


Access Status

Open Access

URI

http://hdl.handle.net/11343/39021
Understanding of the concept of derivative was gauged using an innovative Differentiation Competency Framework that was developed to describe understanding of the concept of derivative. It consists of eighteen competencies for formulation and interpretation of derivatives with, and without, translation between different representations. It clarified the objectives of the curriculum, purpose for using particular CAS activities, and also guided the construction of individual test items on the Differentiation Competency Test that enabled individual and class learning about the concept of derivative to be identified.

The Framework also helped identify each teacher’s privileging characteristics and facilitated analysis of the learning in relation to the teaching.

This study found that using multiple representations was important in developing understanding of the concept of derivative but that the graphical and the symbolic representations were the most useful and important to emphasize and link.

Analysis of the teaching actions showed that the teachers used CAS in ways that were consistent with their teaching approach and preferred use of representations and that a conceptual teaching method and student-centred style supported understanding of the concept of derivative.

Teaching is directly linked to learning and each class developed a different understanding of the concept of derivative that related to the combined effect of their teacher’s privileging characteristics: calculus content, teaching approach, and use of CAS. This study also shows that if a CAS-supported curriculum is to be successfully implemented, it needs to acquire institutional status including a corresponding change in assessment to legitimize new teaching practices.

Keywords
introductory calculus; multiple representations of derivative; teaching with CAS; teacher privileging; learning calculus with CAS; introducing new technology