

Combination of old and new media deepens mathematical understanding

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By combining the trusty old book, pen and paper with the possibilities offered by the computer and the interactive whiteboard, ICT can help to improve students' understanding in maths education. So conclude a team of researchers led by Koen Gravemeijer and Paul Drijvers from the Freudenthal Institute for Science and Mathematics Education (Utrecht University, The Netherlands).

The researchers studied the interaction between learning, teaching and the use of [technological tools](#). To this end they developed so-called applets, small interactive [software components](#) that can be accessed through an Internet browser. The applets are embedded in an [electronic learning](#) environment. Working with applets can help [students](#) gain a better understanding of the [mathematical concept](#) of function and the applications of this.

A new [learning arrangement](#) for students in the 13-14 year age group was developed by the researchers and tested by 700 students and 16 teachers. The researchers established that the lessons worked best when the teachers combined different didactic approaches, when they used different media and when they clearly explained the connection between all of the methods. As the students learn in pairs or in groups using both pen and paper and the digital environment, their learning experiences in the ICT environment are neither isolated nor individual.

In the applet entitled 'AlgebraArrows' the students learn to make and understand chains of operations, to vary input, to form relationships

between representations and to study families of functions. The programme is embedded in an electronic learning environment, so that students can work with it both in the class and at home.

The combined method of working offers opportunities for informal representations of a function and encourages students to look critically at their own work. This is in line with the basic principles of realistic [mathematics education](#). The researchers also conclude that students develop a much better understanding of the mathematical concept of function. The evidence for this came from observations of the students' reasoning and from how they apply the techniques they have learned.

Teacher determines 'orchestration'

During computer work, the teacher plays an important role in encouraging reflection. He or she must connect the computer work to the problem as well as to the 'pen and paper' maths. The learning arrangement with the different didactic approaches and media appears to demand a lot from the teachers. Their own ideas about learning and teaching have a considerable impact on how they react to an ICT-rich learning arrangement.

The research 'Tool Use in an Innovative Learning Arrangement for Mathematics' offers a framework for the design of digital teaching resources and the development of ICT-rich education. The work was funded by the Dutch Programme Council for Educational Research of NWO.

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